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November 3, 1927

Engineering News-Record

Operating the Holland Vehicular Tunnels

With the opening of the twin tunnels near, this article on operation is of unusual interest. Fire protection, traffic control, policing, toll collection, etc., are features.

Surface-Mixed Oiled-Gravel Road On the Wyoming Plains

By C. H. Bowman

An article on a specific example of this comparatively new type of bituminous construction for secondary roads. Working force, plant and cost itemized.

Altering a Meat-Packing Plant in Iowa While in Operation

By M. J. Hess

Into an old three-story structure of wood post and frame construction with brick walls was built a modern fireproof and sanitary cutting floor at a level between the original second and third floors.

Direct-Hoist Railway Lift Bridge on Rock Island Lines

Lift span is balanced by counterweights in the usual manner, but is raised by motors driving the counterweight sheaves, thereby eliminating several thousand feet of cable for raising and lowering the span.

Sewer Tunneling by Day Labor at St. Paul

By William N. Carey

Description of that part of the work done by the city on a $6,000,000 program, with methods and costs of driving and lining 8-ft. tunnels in hazardous ground.

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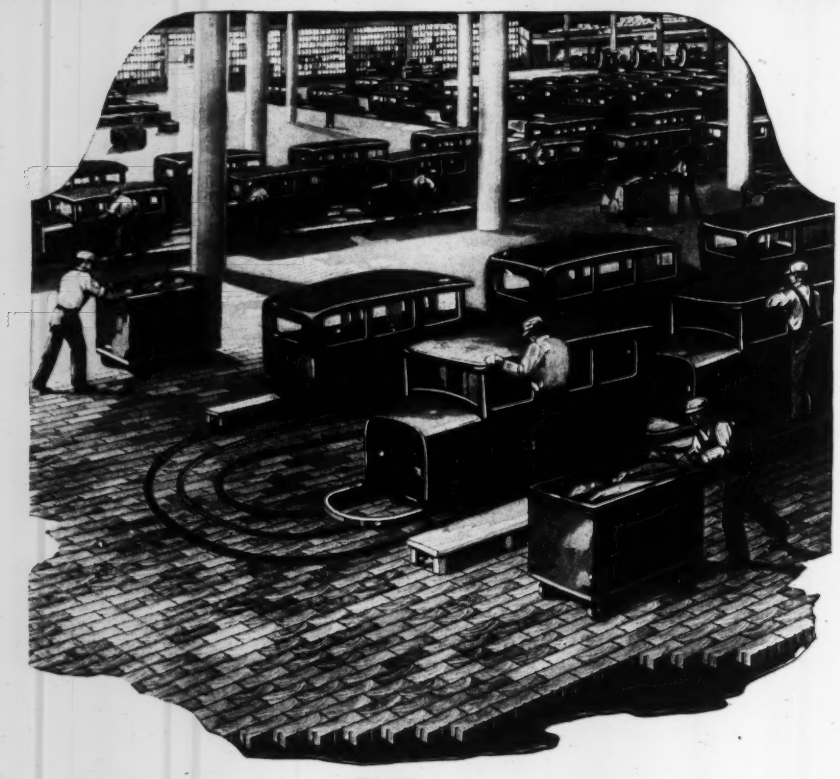

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McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

Volume 99 NEW YORK, NOVEMBER 3, 1927 Number 18

Vehicle Tunnel Operation

DURING the years that the Holland vehicle tunnels under the Hudson River have been building, the question of their operation has been subject to active, even intense, discussion. No similar traffic-way has been built or operated before; the heavy traffic which undoubtedly will crowd the tunnel roadways from the first moment obviously presents many grave problems. Up to now there has been little available information as to how the tunnels were to be arranged and equipped as regards operation. From an article in the present issue it will be seen that the two lines of traffic in each tube—headed in the same direction—have no physical separation; traffic accidents in the one line are therefore not isolated from the second line, but on the other hand free bypassing remains possible if the accident or blockade is of such nature as to permit it. This feature, the carefully studied lighting, remarkably ample provision for warning and notification signals, and the emergency outfits are the distinguishing elements of the operating equipment. In accord with present highway practice, center-line marking is contemplated in the tunnels. Speed-restriction questions remain open. Thus, some important details of operation, as well as the broader question of operating success under various normal and emergency conditions, remain for future determination. The efficacy of the ventilating system and the fire fighting apparatus in the hands of the trained operating staff in case of a conflagration is to be determined before the tunnels are opened. By the end of the year the experience of actual traffic handling will doubtless greatly advance our knowledge of vehicle tunnel operation.

A Jeremiah Speaks

WHEN a banker talks to business men or industrialists he is apt to be cautious and if anything complimentary in what he says. An interesting departure from this rule was made by O. H. Cheney in speaking to the steel fabricators at Pinehurst last week. He told them in pleasant language some plain truths about the need for making their business more profitable by co-operative effort, including research and education as leading items. At present, he says, their industry seems to lack all intra-industry co-operation. One of his telling points is too spicy to pass over here. "If," he said, "in the silent watches of the night I should think to myself that it would be nice to build a marble bird-bath in my garden, I know that tomorrow morning a field engineer of the Portland Cement Association will come and prove to me that the bird-bath would be more beautiful, stronger, cheaper, and 7.31 times more popular with the birds, if it were made of concrete rather than of marble." And he might have added that on at least some of these points the field engineer would have offered research results as proof; for Mr. Cheney knows, as well as did his hearers, that it was not the mere effect of enthusiastic persuasiveness that brought cement and concrete into their present strong position. Mr. Cheney made another good point when he told the fabricators of his surprise at the new movement toward getting steel framing adopted for dwelling houses. He remarked that hitherto anybody who wanted to give the steel industry new business "had to hit it over the head to wake it up." Altogether, what he said was a garland of plain truths, unpalatable, perhaps, but truths nevertheless.

Over-Conservatism, Perhaps

WHILE speaking of the sins of the fabricating industry, Mr. Cheney also sent an arrow at the steel industry as a whole. He charged it with being tonnage crazy. "Volume is not the great need of the structural steel business or of the steel industry as a whole. American business in general has grown volume crazy." It would be hard to find a more appropriate word on the subject of steel. Volume production, with a view to low-cost production and large profits, has been the watchword of the steel industry for decades, and Mr. Cheney suggests that that is why the rate of profits of the industry is below the average, and its returns on invested capital are low. Perhaps it is also the reason for occasional apprehensions about overseas competition despite an almost impregnable tariff bulwark. At least some of the foreign steel is imported on the score of quality, so that evidently quality has a market value in this field as in others. The importance of the quality ideal as an inspirational objective and a guiding force in any human activity, steelmaking included, cannot be doubted. Now that the United States Steel Corporation has entered definitely into organized research, it may well be that the trend is in the direction of replacing the tonnage ideal by one of quality. The drive for tonnage is, after all, a result mainly of over-conservatism, for tonnage was the watchword of the pioneer days. Steelmaking longer than most industries has remained under the sway of traditions born in the nineteenth century. But there are evidences that a new day is coming.

Surface-Mixed Oil Roads

THE surface-mixed oiled-gravel road work in Wyoming, which is described in this issue, commands attention as a means promising wide usefulness in developing an intermediate road type between traffic bound stone and gravel roads and the expensive pavement types. Surface-mixed oiling is quite different from the long practiced surface oiling of roads to lay the dust and hold the top skin from raveling and blowing off into the fields. Again it is quite different from bituminous macadam produced by penetration with asphaltic oils or tars, or from asphaltic concrete produced by mix-

ing proportioned, screened and graded aggregates with bitumen. It is an intermediate type. The oil applied to the road is mixed with the surfacing metal by a process of scarifying, harrowing and blading until a mixture is produced akin to an asphaltic concrete but entirely without its precision of proportioning or its purity of bitumen. A light asphaltic oil is used. The road metal is fine crusher-run stone or gravel often with an admixture of binder. When oiled by surface mixing the road is compacted under traffic and is maintained by frequent blading and dragging. This is a type of construction by itself among bituminous roads. Its popularity in the west comes both from the fact that it provides an excellent light traffic road and an excellent initial improvement in the stage construction of roads on which rapid increase of traffic is expected.

Examination of Insurance Brokers

A LETTER in this issue expresses commendation of the action taken by the insurance commissioner of Pennsylvania requiring insurance brokers to pass examinations. This action, following the adoption by Iowa and Illinois of more stringent regulations in licensing brokers and followed by the recent hearing given by the superintendent of insurance, James H. Beha, to brokers' associations and individual brokers urging the requirement of examinations in New York, has particular significance. For half a dozen years engineers and contractors doing public work have been urgently demanding reform in contract bonding practices. It is not now the time to review this discussion, which has many times been referred to in these columns, but so great has been the animosity developed that it is no secret that contractors are seeking means to circumvent entirely the necessity of corporate bonding and highway engineers in a number of states are urging that the commonwealth should carry its own insurance both as a measure of economy and to avoid the many annoyances of having to deal with unwise bonding of irresponsible contractors. The belief of these engineers is becoming general that under prevailing conditions the ability to secure a corporate bond in only a slight degree signifies responsibility. They also consider, and in this view they are supported by the contractors' associations, that the trouble rests largely with the insurance brokers who belong to the class stigmatized by our correspondent as "working solely for commission." Obviously the reform of brokerage practices is not going to correct evils as widespread and complex as now prevail in surety bonding but it is a step toward correction and would seem to deserve support by contractors and engineers.

Selling Engineering by the Quart

IN observing the growing disposition of engineers toward concerted action to secure public recognition and adequate compensation one must inquire why organization for this purpose alone should be necessary. The most frequent answer doubtless will be that it is because the engineer has allowed himself to be shunted into a corner by the fiction that his works and not his words set his standards of pay. True though this may be, is it not probable that the employers of engineers in the subordinate grades have classified and graded their assistants until it is popular belief that engineering skill may be purchased at an exact measured price? No two assistant engineers, no more than two musical composers, are cast in the same mold. Acknowledgment of special or superior talents in a material way by consulting firms might go a long way toward creating a public conscience that would result in the engineer in city employ securing the compensation to which he is entitled. This does not mean that classification is not necessary or advisable; but classification to the point at which engineering can be sold by the quart will change the young engineers' ideas and ideals to mass mechanics.

Miniature Engineering

IN AN interesting paper read before the American Society of Mechanical Engineers recently, Prof. S. W. Parr spoke of the imperfections of house-heating furnaces. He asserted that the larger part of city smoke and grime comes from these domestic plants, and held out little hope for improvement in this state of affairs. So long as raw coal is fired, "no matter by what name the furnace or the coal is known they will smoke just the same." Smoke production is only one of the unsatisfactory features of the house-heating plant, as every householder knows, and possibly, as Professor Parr suggests concerning smoke, we will continue to be troubled by these features far into the future. The miniature engineering represented in the home offers problems quite different from those of large-scale work. But as technical progress these days is rapid, and affects nearly all departments of the field of living, there is at least a fair chance that the problems of the domestic furnace will be solved before long. A great deal of effective work has been done in domestic engineering in the past decade or two—the development of the mechanical icebox, for example—and the field is so promising that we believe it will attract much further effort. There are not only mechanical problems, by the way, but equally important structural ones; civil engineers have quite as much opportunity as the machinery and power men. In the final end we may succeed in making the dwelling house as thoroughly designed and as safe a place as the modern office building; at present it is half a century nearer the dark ages.

Winter Work on Railways

IN connection with the movement for and the possibilities of winter work for general construction, as outlined by the recent series of articles in *Engineering News-Record*, it is of interest to record that railway organizations are definitely recommending the rearrangement of bridge work and track work so as to provide for a continual program throughout the year, in place of the seasonal arrangement which is now general practice. With an all-year program, a uniform and permanent force can be maintained, resulting in a more competent force and in better and more economical work than when the forces are cut to a minimum annually on the advent of cold weather and recruited with green men the next spring. Furthermore, with the work thus distributed, there is avoided the usual rush due to delay in getting started and haste in finishing as the end of the working season approaches.

In railway work, as in general construction, it has been an accepted condition that practically no work can be done during cold weather. But trial and experience have disproved this belief, while investigation has shown that in most cases the severe weather comes only in comparatively short spells and that a good proportion of the

winter season consists of fine weather with moderate temperature. Even in sections where heavy snowfall occurs it has been proved that much track work can be done efficiently and economically, both in the way of heavy renewals and of the lighter routine maintenance. In addition, this winter work eliminates the congestion and difficulty which usually result from concentrating the maintenance work in the heavy-traffic summer months when traffic is at its heaviest.

Attention is called to this situation in the railway field by the fact that at the recent annual meetings of both he Railway Roadmasters Association and the Railway Bridge and Building Association committee reports were presented on the subject of more uniform distribution of work throughout the year. Both reports, which met with approval, advocated this system and outlined its advantages. The latter association has already gone on record as advocating all-the-year work for railway painting forces, and it now presents the conclusion that a similar practice is advisable for the bridge and building forces. The work would be scheduled on a program covering the entire year, by which means such operations as would interfere with traffic could be assigned to the months of light traffic. Such a program is considered essential for economic performance, and it is assumed that it would not be disturbed or interfered with except in matters of emergency.

Railway engineers and supervising officers are pretty well agreed as to the many practical and economic advantages of a 12-month working year with a uniform force of skilled men. It remains to convince the higher officials and those who handle the purse strings that these are real advantages and that there are many serious disadvantages in the present plan by which well-planned programs of work may be disrupted suddenly by arbitrary orders for a reduction of force at any time. Another point, and one which is apt to be overlooked by these higher officials, is the value of the loyalty which is inherent in a permanent force of long-service employees, but which cannot be expected of men who are picked up at haphazard when required, and are liable to summary dismissal at any time that an official thinks immediate or temporary reduction of expense is desirable.

Highway Turnover

CONTINUITY of service is the greatest need today in state highway administration. The tragic lack of it is one of the greatest dangers which confront the development of public roads improvement. Within a year 21 states through legislation or changes in political party control have changed heads of state road departments. None of these states has an annual highway business smaller than several million dollars; in several of them it ranges from a score of millions to three-score millions of dollars. What would the business world think of the soundness of railway management and of the management of public service corporations if they recorded porportionately as great an annual change in administrative control? It can be truly claimed that not every twelve months bring as many changes as those of the past year, but they do record half as many changes.

It may be urged that, even though state highway department heads change, the working staff of engineers in the grades below chief engineer remains continuous. This is in a measure true, and because it is true hazards are decreased. Still, a new directing head every year or two does not conduce to a smoothly functioning staff, and in the last year there have been occasions where the staff has been changed from top to bottom. This is dangerous business when conducting operations as great as the road construction and maintenance work of even our very smallest road-building states. It is in no criticism of the new directing heads of 21 state highway departments that this warning is urged. With such conditions continuing, the new officials, however good their selection may have been, are certain of no long tenure of position. They are treading the same ground as did their predecessors.

It has already been said that business men would show a stern countenance to the railways or the public service comporations if they permitted similar conditions to prevail. Possibly a frowning aspect generally of chambers of commerce highway committees—all have them nowadays—would help to stiffen up road administration practices. Certainly their intervention here would count for more good than in questions of pavement design and construction technique, on which they more often undertake to bring influence.

Draft Tube "Thumps"

DRAFT tubes are a more fruitful source of low-velocity vibration than any other part of the hydro-electric plant because there the hydraulic flow makes the transition from pressure to vacuum and both pressure and vacuum must obtain in the same chamber. The water leaves the runner with considerable velocity and has a tendency to hug the draft-tube shell, while the accumulated vacuum tends to draw air or air and water into the center of the draft tube. There is thus a continual clash of the forces of pressure and vacuum, with the result that, unless there is careful control, impact will result. The vibration resulting from this impact is of a low order, to be sure, but it lessens efficiency and causes undesirable vibration in the penstock. Breathing of penstocks as much as 3,000 ft. from the power house has been traced through the units to causes within the draft tube and there is at least one case on record in which this breathing in a wood-stave penstock punched holes in the line where it passed through concrete saddles. It is sure to cause excessive wear in any parts that may be loose or lightly fitted, besides making an objectionable noise inside the power house.

As higher draft-tube efficiencies and higher vacuums have come into vogue, the draft tube cones have been made higher and higher, until in some vertical turbines the cone has actually made contact with the lower end of the turbine shaft. This expedient has been an effective means of reducing trouble from draft-tube thumps, because with the central section so occupied there has been less opportunity for the formation of voids that have a tendency under the varying effects of pressure and vacuum to cause more or less violent reactions in the free mixture of air and water. Work with models does not help very much in preparing to combat problems of this sort because the theory of homologous similitude, used so extensively in applying the results of experiments with models, obviously does not enable the experimenter to predict vibration that becomes important only as units of large size are operated at high speeds. The improvement of draft tube design is one of those phases of hydro-electric development in which the manufacturer can attain the greatest success by co-operation with the power company. Highly commendable co-operation of this sort is now being secured in joint committees working as technical sections of the National Electric Light Association.

Method of Operating Holland Vehicular Tunnels

Wide Plaza at New York Entrance for Traffic from Several Directions—Two Lanes of Traffic Move in Same Direction in Each Tunnel—Traffic Police Throughout the Tunnels

Construction work on the Holland vehicular tunnels under the Hudson River at New York is drawing to a close. Within a few days the tunnels will be open. The methods of constructing them have been described in articles appearing in this journal during the past few years. Recently there was published an article describing the methods to be used in ventilating the tunnels ("Engineering News-Record" June 9, 1927, p. 934). There remains one feature to be described, the methods to be employed in operating them. This article deals with that feature.

SINCE the success of the Holland vehicular tunnels at New York as an aid to cross-river traffic depends upon two factors, the facility and safety with which traffic can be handled through the tunnels themselves and the arrangements at the exit and entrance plazas for receiving and dispersing the maximum number of vehicles which can pass through the tunnels, much thought has been given to both problems and considerable sums of money have been spent both by the tunnel commissions and the city of New York and State of New Jersey in improving the facilities for entrance and exit.

Entrance and Exit Plazas—Traffic conditions at the New York end differ so widely from those at the New Jersey end of the tunnels that entirely different plaza arrangements are required. The general street plan at the two ends of the tunnels is shown in Fig. 1. In New Jersey the entrance to the eastbound tunnel is some distance from a main north and south artery of traffic and vehicles approaching it move through a street where there is little possibility of cross traffic because the street is flanked by railroad terminals. Under such conditions traffic naturally will form into lanes concentrating at the toll booths. Jersey Ave., the principal north and south route on the lowlands along the river, is five blocks from the tunnel portal. Beyond it two viaducts rise from the lowlands to connections with the main highways on the heights to the west.

In the street changes to improve the tunnel approaches Fourteenth St. has been widened as far as Jersey Ave. to form the exit plaza, and Twelfth St. has been widened to form the entrance plaza. Jersey Ave. has been widened between Twelfth and Fourteenth Sts. Additional width for the entrance plaza has been obtained by an agreement between the tunnel commissions and the Erie R.R. Co., owner of the property to the south of Twelfth St., to the effect that the railroad will not build a sidewalk along that side of the street and will place all loading platforms within the property lines of warehouses which it may build adjacent to the street. This gives a full width of 160 ft. for the roadway approaching the toll booths, a width sufficient for seven lanes of traffic.

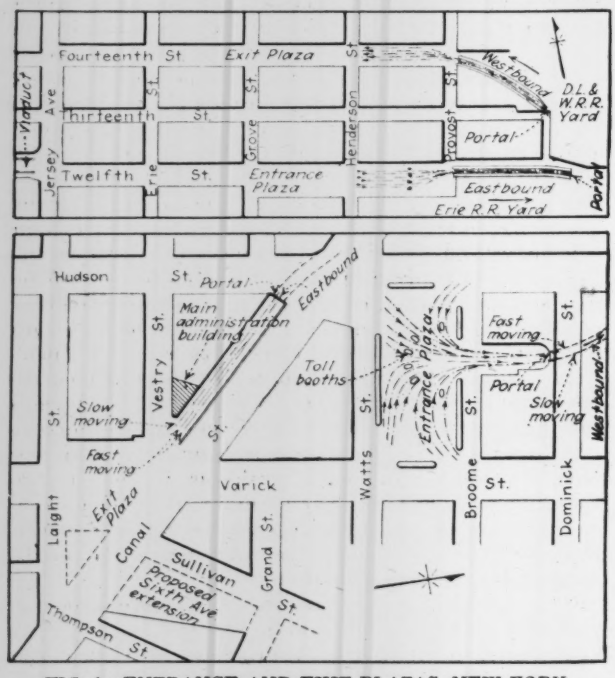


FIG. 1—ENTRANCE AND EXIT PLAZAS, NEW YORK AND NEW JERSEY

Above: Entrance and exit plazas in Jersey City. Below: The plazas in New York.

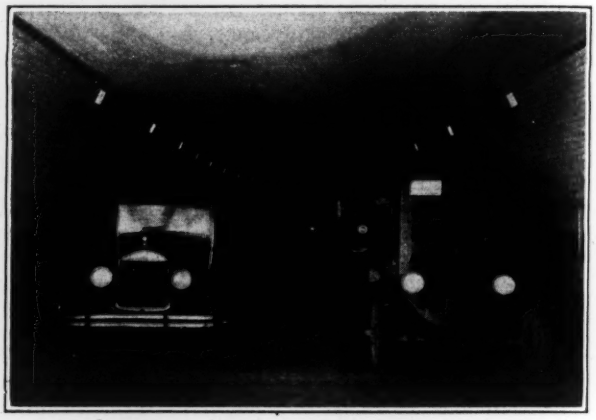


FIG. 2—INTERIOR OF NORTH TUNNEL

The New Jersey exit plaza presents no special problems. Like the entrance plaza, it extends through four blocks before reaching a main cross street.

On the New York side, both the entrance and exit plazas are in a congested section of the city where no simple layout such as was adopted for New Jersey is possible. The tunnels cross under three busy north-and-south streets, West, Greenwich and Hudson, and come to the surface before reaching Varick, the fourth north-and-south street, the exit portal being parallel to and at one side of Canal St., the main east and west thoroughfare.

For the dispersion of the outcoming traffic, the commission and the city created an exit plaza by razing the

buildings on the triangle between Canal, Varick and Laight Sts., and along the west side of Canal St. between Laight and Vestry Sts. Traffic from the tunnel may continue across town on Canal St., turn west through Vestry St., south on Varick St. or north through Varick St. or the extension of Sixth Ave., which will soon be open to Canal St.

For the entrance plaza the commission razed the whole block between Watts, Varick, Broome and Hudson Sts. and cut away the point between Canal and Watts Sts. In a wide semicircle near the center of the plaza are set eight toll booths to provide for 16 lanes of traffic converging on the tunnel portal. This large number of traffic lanes was considered necessary because any attempt to marshal the traffic as it approaches from all directions could not but result in congestion and delay. After the tunnel has been opened it may be found that certain lanes of traffic can be closed for part or all the time.

Traffic Control—Control of traffic through the tunnels will begin out at the toll booths where the first lights of the tunnel signal system are located. Within the tunnels traffic will be controlled by signal lights spaced 240 ft. apart and by traffic police located at 480-ft. intervals.

Traffic signals have two normal indications, green for proceed and red for stop, and two special indications, an illuminated sign, "Stop Engine," to be used when traffic is to be held up for some time, and a flashing yellow light to indicate to traffic officers and drivers that the vehicles must be brought into one lane to permit emergency equipment to pass in the other lane.

The stop signals can be set from any of the traffic officer's stations, but the "stop engine" signals can only be cleared from the control room in the administration building where an illuminated chart shows the indication of all signals. This provision places responsibility for resumption of movement with an officer familiar with conditions throughout the entire tunnel. Each traffic officer has telephone connections with the central control room. When more than one traffic officer sets the stop signal, each setting is recorded in the control room, so that the operator is advised of the added trouble in case all signals may have been set red for the first trouble.

Safety Precautions—Provision has been made for the two major emergencies, fire and breakdown. On the assumption that the majority of fires which occur in the tunnel will be oil or gasoline fires, chemical extinguishers of the foam producing type have been adopted as the most suitable. At first it was thought foam could be piped from a central plant to outlets in the tunnel, but upon further study it was found that such a scheme had many drawbacks. Instead, portable foam extinguishers of 5- and 2½-gal. capacity have been placed in the tunnel and the emergency trucks are equipped with foam generators. The small extinguishers, to maintain their efficiency, have to be kept at a temperature above 50 deg. F. Consequently, they could not be hung in the open tunnel exposed to the low temperatures which will exist there during the winter months. Instead, they have been inclosed in recesses which can be heated. The doors of the recesses are close fitting but cannot be locked. Each extinguisher is set upon a shelf to facilitate its removal from the recess. Below the shelf there is an electric light which not only heats the recess but also illuminates a red bull's-eye in the lower part of the recess door which serves to indicate the location of each extinguisher.

One or two 5-gal. extinguishers in separate recesses are located every 125 ft. throughout the tunnel, and at every 240-ft. interval is a large recess containing five extinguishers. Thus, at least 42½ gal. of foam solution are available in each 240-ft. section of the tunnel. The

FIG. 3—INTERIOR OF COMPLETED TUNNEL

Left to right—Refuge niche with fresh air inlet, single fire extinguisher recess, fire alarm and telephone boxes, hose rack recess, multiple extinguisher recesses, and signal wire box. Traffic signal, upper right center. Along the roadway are the inlet to the drain, and above the curb is the continuous air inlet. Exhaust ports are in the ceiling, upper left side.

emergency trucks located at each end of the tunnels carry a 200-gal. water tank and a large quantity of foam powder. (Foam is generated by mixing water with a pow-

FIG. 4—ENTRANCE PLAZA AT NEW YORK
The tunnel entrance is at the left. Toll booths (under construction form a semicircle around the entrance.

dered chemical compound.) The 200-gal. water supply is sufficient to operate the equipment until additional water can be obtained from the water main in the tunnel and the supply of foam powder is sufficient for ½-hour operation.

As a further precaution, the 6-in. water main which is located in each side wall of each tunnel is provided with two outlets every 120 ft., one directly connected to a rack of hose for fire fighting and one for flushing the roadway or to supply the portable fire apparatus. The two mains are cross-connected at five points. Adjoining every second hose box is a sand box for fire fighting or for sanding oil on the roadway.

The fire mains have three points of supply in New York and two in New Jersey. They are equipped with booster pumps in the tunnel for use in case the pressure falls below requirements.

Fire alarm boxes are located at each traffic officer's niche, every 480 ft. throughout the tunnels.

Blockades—In case of a blockade, the traffic officer nearest to the accident will set the stop signals back of the blockade and advise the control office of the cause of trouble. Then, if aid is needed, the emergency truck from the exit end of the tunnel from which the alarm is given can be run in to bring out the disabled car. These trucks are built to operate in either direction with equal facility.

In case the trouble is of such magnitude as to require the occupants of vehicles to leave either tunnel, emergency exits are located at each of the land and river ventilating shafts and there is a crossover between the tunnels at the mid-river sump.

Lighting—The tunnels are illuminated by electric lights in recesses covered with frosted glass to diffuse the light, set high up on the side walls. They are spaced 20 ft. apart except near the entrance portals, where the greatest amount of light is needed by drivers coming in from the daylight. There, the recesses are spaced 10 ft. apart for a short distance and then 15 ft. apart for a further distance. Provision is made for one 200-watt lamp in each recess but 150-watt lamps will be tried out when the tunnel is opened. The indications are that the smaller lamp will give adequate illumination.

Alternate opposite pairs of lights are on independent circuits so that half the lights are supplied with current from New Jersey and half from New York. At least two sources of current are available in each state. All the lights may be fed from each source.

Drainage—The roadway in each tunnel has a fall of 1½ in. transversely to direct all water to a longitudinal drain behind the curb at the low side of the roadway. Water from these drains runs to five sump points, one under each ventilating shaft and one at the river sump, located in the rock ledge beyond the pierhead line at New York, where automatic pumps force the water up to the river or city sewers. The drains for those portions of the approach roadways at the portals which slope toward the tunnel are designed to carry water in excess of the maximum recorded rainfall. The total capacity of the pumps is 6,850 gal. per min.

Operating Personnel—Toll collectors, emergency truck operators and traffic police in the tunnels and on the plazas controlled by the commission, the two New Jersey plazas and the entrance plaza at New York, are to be employees of the commission. They are to be provided with rest rooms, baths and locker rooms in the administration buildings located near each end of the tunnels. Garage facilities for the emergency trucks also are included in each administration building. The traffic police will have all the powers of summons and arrest of city police.

Office space for the permanent staff, including accountants and a small force to continue the engineering studies

FIG. 5—EMERGENCY TRUCK
Fire and break-down truck designed to run in either direction. The forward "dolly" has a capacity of six tons.

of the commission, is provided in the New York administration building where the main control room also is located.

The tunnels are to be opened for general traffic on Nov. 13.

This article concludes the series of articles on the vehicular tunnels which have appeared in *Engineering News-Record*. The previous articles were: A general

statement of the work to be undertaken, Feb. 19, 1920, p. 357; tests upon the pollution of air by automobile gases, April 7, 1921, p. 602; start of work on the subaqueous tunnels, April 6, 1922, p. 574; sinking of the deep shafts at the New Jersey side, Feb. 8, 1923, p. 242; driving the subaqueous tunnels, May 8, 1924, p. 798; paving the roadways, Oct. 29, 1925, p. 726; lining the tunnels, Dec. 3, 1925, p. 902; and ventilation, June 9, 1927, p. 934.

Construction of the tunnels has been carried on under the direction of two commissions acting jointly, the New Jersey Interstate Bridge & Tunnel Commission created by the New Jersey Legislature in 1918, and the New York State Bridge & Tunnel Commission created by the New York State Legislature in 1919.

The engineering work has been in charge of a joint engineering staff under the direction at first of the late Clifford M. Holland, then under his successor, the late Milton H. Freeman, and since March, 1925, under the present chief engineer, Ole Singstad, who served as engineer of design until his promotion to be chief engineer. Ralph Smillie has served as engineer of design since Mr. Singstad's promotion. A. C. Davis, mechanical engineer, and J. N. Dodd, electrical engineer, have had direct charge of the design and installation of the mechanical and electrical equipment.

Surface-Mixed Oiled-Gravel Road On Wyoming Plains

New Type of Asphaltic Oil Road Construction for Fine Crushed Surfaces—Working Force Plant and Cost Itemized

By C. H. Bowman
District Engineer, Wyoming Highway Department, Casper, Wyo.

Developed in Oregon and later carried to greater use in California, a bituminous construction for intermediate type roads, known as surface mix, has recently gained particular notice in the far western states. This article is a description of a specific example, not strictly representative because an error was made in the first proportioning of the oil, but fairly typical in other respects. For recent comprehensive studies on the surface-mix and surface-treatment methods the road engineer may consult "Public Roads" for September, 1927, or the pamphlet "Light Asphaltic Oil Roads Surfaces," published by the Division of Highways, California Department of Public Works.—Editor.

In developing the Salt Creek oil fields in Wyoming, a road was built to Casper on the railway in 1918-19, with federal aid. This road was 39.4 miles long and at first was only graded and drained to engineering standards. Since that time, as funds were available, the road has been brought to a higher standard under three separate contracts. Two are paving projects covering approximately 24 miles. The balance, 15.4 miles, was improved in 1926. The improvement consisted of betterment in gradient, alignment and drainage structures with a crushed gravel surface 6 in. deep and 18 ft. wide.

The federal aid agreement provided that the gravel surface should be oiled but nothing was specified as to the method of oiling. Following studies of reports on the mixing method of oiled gravel surfaces used by the California State Highway Department and a personal inspection by State Highway Superintendent Z. E. Sevison, of the work then in progress at Barstow, Calif., it was determined to use the mixing method on the 15.4 miles of crushed gravel surfacing.

Surfacing—The highway lies at an average elevation of approximately one mile above sea level, with temperatures ranging from 40 deg. below zero to 95 deg. above zero. This region is arid (annual rainfall 13 in.). High winds prevail throughout the year. The gravel surface was completed in October, 1926, and was compacted under a traffic of 600 motor vehicles per day. The gravel was a graded material, the fines being closely regulated at the plant. The specifications called for not more than 35 per cent passing a sieve with ¼-in. openings. A sieve analysis, an average of twelve samples of material actually placed on the road, follows:

	Per Cent
Retained on 1 in.	5.445
Retained on ¾ in.	19.443
Retained on ½ in.	19.472
Retained on ¼ in.	21.037
	65.397
Retained on 10 sieve	15.700
Retained on 40 sieve	14.393
Pass 40 sieve	4.510
	34.603
Total	100.00

Oil Specification—A local oil was used. The Midwest Refining Co., with a refinery at Casper, Wyo., agreed to produce a road oil answering the specifications from the production of the Poison Spider oil field, about 25 miles from Casper and connected to the refinery by pipe line. This oil is the purest asphaltic base oil in the state, with no trace of paraffin. The order as placed with the refinery was: The road oil delivered shall conform to the general specifications and be further limited as follows: Specific viscosity Engler 122 deg. F. 50 c.c.—30 to 35; 80 penetration residue at 77 deg. F. not less than 60 per cent. The general specifications were:

Oil asphalt shall be a natural asphaltic base crude and shall have a specific viscosity—Engler—at 122 deg. F. of not less than 25 nor more than 45. Water and sediment combined shall not exceed more than 2 per cent. The oil shall contain not less than 60 nor more than 70 per cent of asphaltic residue, having a penetration of 80 at 77 deg. F. Test methods shall be as defined in U. S. Department of Agriculture Bulletin 1216 for all materials and tests involved.

California Practice Followed—Naturally, the department made all possible use of the knowledge gained by a study of methods and equipment as established by experiment and practice in California. The work was undertaken with this previous work to guide and with the thought that our climatic conditions are different. Equipment on hand for the regular maintenance work was used. The only new equipment bought was a double-disk harrow and a spring-tooth harrow. The sequence of operations is practically the same as those at Barstow and is as follows: (1) Scarifying to a depth of 3 in., (2) disking and harrowing, (3) first application of oil, (4) disking and harrowing, (5) second application of oil, (6) disking and harrowing, (7) mixing with grader, and (8) laying down for traffic. At Barstow 1½ gal. of oil per square yard was used, while on this project 1 gal. per square yard was used.

Preparing the Grade—Scarifying was comparatively easy, as the gravel surface had been under traffic for nine months only. A 10-ft. blade grader, with scarifier attach-

ment, was used. The power was a 10-ton tractor. This power unit was able to pull the scarifier with its full set of seven teeth. An average of three sets of teeth per day was used on the average run of approximately 4000 ft. Scarifying tractors were followed by the double-disk harrow and spring-tooth harrow. A 5-ton tractor supplied the power. These two harrows pulverized and leveled the material satisfactorily in two trips.

Oil was delivered an average haul distance of nine miles to an elevated spur adjacent to an oil field boiler house in order that the oil might be run by gravity into the tank trucks. Steam was introduced into the tank car steam coils and the oil heated to approximately 120 deg. At this temperature the oil would flow readily under gravity into the tank trucks, would pump readily from the tank trucks into the distributor and work through the distributor satisfactorily. Two 2½-ton trucks,

TABLE I—COST OF SURFACE MIX CONSTRUCTION ON WYOMING OIL FIELD ROAD

(Length of Project, 15.487 miles = 163,543 sq.yd. Number of actual working days, 20. Average run, 4088.56 ft.)

Scarifying	163,543 sq.yd. at .0078	=	$1,275.64
Oiling	163,543 sq.yd. at .0065	=	1,063.03
Harrowing	163,543 sq.yd. at .0046	=	752.30
Processing and mixing	163,543 sq.yd. at .0078	=	1,275.64
Finishing	163,543 sq.yd. at .0043	=	703.23
Oil delivered	163,543 sq.yd. at .0650	=	10,630.30
Overhead	163,543 sq.yd. at .0046	=	752.29
Total	163,543 sq.yd. at .1006	=	$16,452.43

on which were mounted 610-gal. tanks, were used to transport the oil from the tank car to the distributor on the work. Filling the truck tanks by gravity from the tank car consumed about ten minutes for each tankful. Pumping each tank of oil into the distributor on its arrival on the job consumed an equal amount of time.

Oiling was done with a pressure distributor operated by chain drive off the truck drive-shaft. Efficient workmen, who had worked for the department for several years and had had previous experience with the oiler, secured a very uniform distribution. The theoretical application of oil was 1 gal. per square yard. The distributor tank held 600 gal. One half of the road was covered with one distribution. Each tank covered 1,200 ft. for each application of ½ gal. per square yard. As soon as the ½ gal. per square yard was applied on a stretch of surfacing it was harrowed with the double-disk and the spring-tooth harrow pulled by a 5-ton tractor.

Mixing the Surfacing—In this type of construction, after the oil is applied and harrowed in, the mixing or processing begins and is continued until the mixture has assumed a uniform light brown color. For this work 10-ft. blade graders drawn by 10-ton tractors were used. At the beginning of the work the material was not processed enough and not enough material was mixed for the amount of oil applied. Later this was sacrificed and reprocessed with excellent results. With the original processing a 2-in. mat was secured, but, as it later developed, the mixture was too "fat." On sacrifying and reprocessing, going deeper to secure more material, a uniform brown color was secured with a mat 3 in. in depth. This apparently is as thick a mat as was secured at Barstow, in California, with an application of 1½ gal. per square yard as against the 1 gal. per square yard used on this project. This may be accounted for by the fact that apparently the fines composed a much larger part of the California gravel than they did of the gravel under discussion.

About a week after the original job was completed it was decided that sufficient processing had not been done and that the oil content of the gravel processed was too great. A 10-ft. blade drawn by a 10-ton tractor operated by men employed on the original job was put to work scarifying and reprocessing. A second small blade drawn by a truck was used to maintain the surface after it was laid down. This scarifying was easily done and the extra processing cost about $125 per mile. It is believed that the later processing added little more to the cost of the completed job than had the work been done during the original construction.

Much better results were secured in mixing the material in the final processing than had been secured on the original work. This was on account of the fact that experienced workmen, interested in the success of the job, were employed. The best mix was secured, by handling the material in two rolls or ridges. These ridges rolled under each turn of the blade in a very satisfactory manner. These turns had to be made many times to secure the desirable uniform light brown color. The mix finally secured carried, on the otherwise compacted surface, a light mulch of loose material which was carefully maintained for some time after the job was completed.

The average daily traffic over the highway oiled is approximately 600 motor vehicles a day. The distributor covered 9 ft., or one-half the roadbed at one trip. While this half was being oiled, traffic took the other half. As soon as the first part was oiled and while the distributor was being reloaded, the harrowing of the first application was carried on. While the second half of the roadbed was being oiled, traffic was allowed to run over the first half and throughout the processing the work was handled so that traffic was inconvenienced very little.

Working Force, Plant and Costs—The construction crew consisted of 17 men: One superintendent; one mechanic; four truck drivers on tank trucks; one truck driver, pulling the special grader with a 12-ft. maintenance blade; four tractor operators, graders and harrows; three blade and scarifier men; one fireman, one cook, and one handy man unloading oil at tank cars.

The equipment employed comprised one stationary 60-hp. boiler; four 2-ton trucks, hauling oil; one 3-ton truck pulling maintenance blade; two roadsters for foreman superintendent and mechanic; two 10-ft. blade scarifier graders; one 12-ft. blade grader for laying down mix; one special grader with a 12-ft. maintenance blade; one double-disk harrow; one spring-tooth harrow; three 10-ton tractors pulling graders; one 5-ton tractor pulling the special grader; one water tank, and three camp wagons with camp equipment.

The rental and depreciation charges allowed for equipment were:

	Depreciation	Rent
10-ton Holt per day	$1.00	$17.00
5-ton Holt per day	1.00	18.00
Packard trucks per day	1.00	9.00
White trucks per day	1.00	6.50
F.W.D. truck per day	2.00	10.50
Adams 8-B grader per day	2.00	3.50
Russell super reliance per day	2.00	3.20
Scarifier attachment per day	.25	6.00
Disk harrow per day	.20	.20
Spring-tooth harrow per day	.20	.20
Ford per mile	.02	.04
Chevrolet per mile	.02	.035
Camp wagon per day	.20	.05
Tank wagon per day	1.00	.04
Tent per day	.05	.02

The accompanying Table I gives the construction costs; in addition there was an expense of $.0125 per square yard due to the reprocessing mentioned in this report. Oil at the refinery cost $0.045 per gallon; the freight, refinery to spur, $.008 per gallon, and steaming and hauling, spur to project, $.013 per gallon.

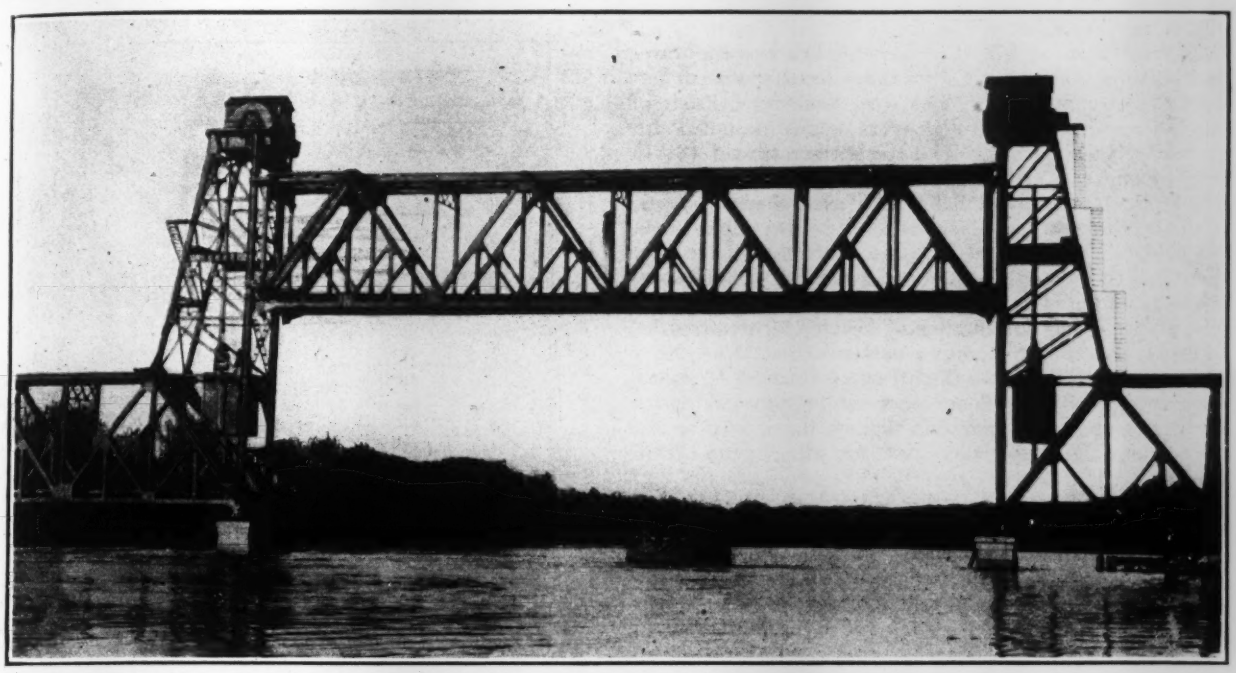


FIG. 1—WHITE RIVER LIFT BRIDGE; ROCK ISLAND LINES

Direct-Hoist Lift Bridge; Rock Island Lines

Lift Span Balanced by Counterweights in Usual Manner but Raised by Motors Driving the Counterweight Sheaves—Hydraulic Equalizer for Cables

A VERTICAL-LIFT span having a novel direct-drive hoisting system is the principal feature of the new White River bridge of the Chicago, Rock Island & Pacific Ry. at De Valls Bluff, Ark., on the line between Memphis and Little Rock. A view of the bridge is shown in Fig. 1. In the new operating system the counterweight cables attached to the four corners of the lift span pass over motor-driven sheaves on the tops of the towers and the span is raised or lowered by the rotation of these sheaves. The principal advantage claimed for this hoisting system is the elimination of several thousand feet of cable for raising and lowering the span. A hydraulic equalizing system has also been introduced; in place of trains of equalizing beams for insuring uniform tension in the counterweight cables, there are hydraulic equalizers which form a link between the cables and the counterweights and can be adjusted at any future time.

General Arrangement—A lift span of 182 ft. 4 in. c. to c. of end bearings gives a clear channel width of

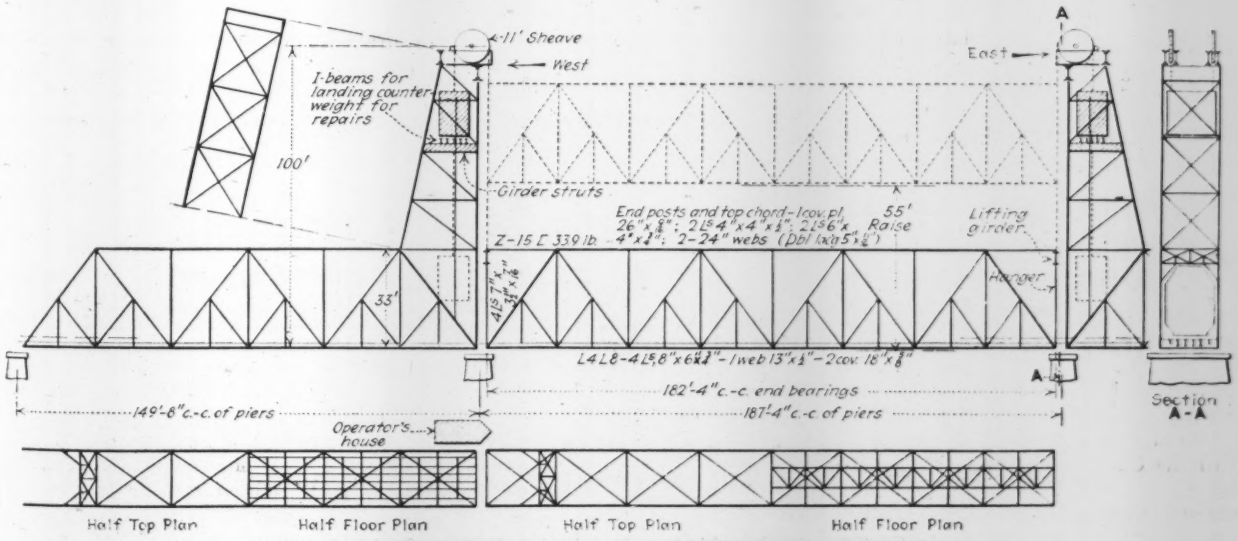


FIG 2—LIFT SPAN, WITH FLANKING SPANS AND TOWERS

175 ft. and is shown in Fig. 2. It is flanked on each side by a fixed span of 147 ft. 3 in. which carries the tower and hoisting machinery. Two other fixed spans connect with the west approach. The steel structure consists of single-track riveted through-truss spans designed for Cooper's E-65 loading. The trusses are spaced 18½ ft. c. to c., and are 33 ft. deep. Both approaches are creosoted pile trestles with ballasted decks, there being 92 spans on the east and 52 spans on the west side. In the old bridge, a 219½-ft. swing span was followed by three fixed spans 146 to 150 ft. long, all being through-truss spans. Settlement of the masonry piers and the necessity of providing for the use of heavier locomotives led to replacing the bridge with a new structure.

Structural Design—In the lift span, features of special note are the shallow floor construction, the subdivision of truss panels to permit this shallow floor, and the use of portal or lifting girders for the attachment of the cables.

A shallow floor is desirable since high-water level is within a few inches of the bottom chords of the bridge. In fact, during the recent floods the water reached nearly to the base of rail, which is 3 ft. 8½ in. above the clearance line of lowest steel. The floor system, Fig. 3, consists of 40½-in. plate-girder floorbeams 11 ft. 4 in. apart, framed between the truss posts at panel and subpanel points carrying two lines of 15-in. I-beam stringers to which the track ties are secured by hook bolts. On the fixed spans, with panels 12 ft. 3 in. long, the 30½-in. floorbeams carry six lines of I-beam stringers. These spans have a solid deck of creosoted ties packed tightly together to carry a ballasted track.

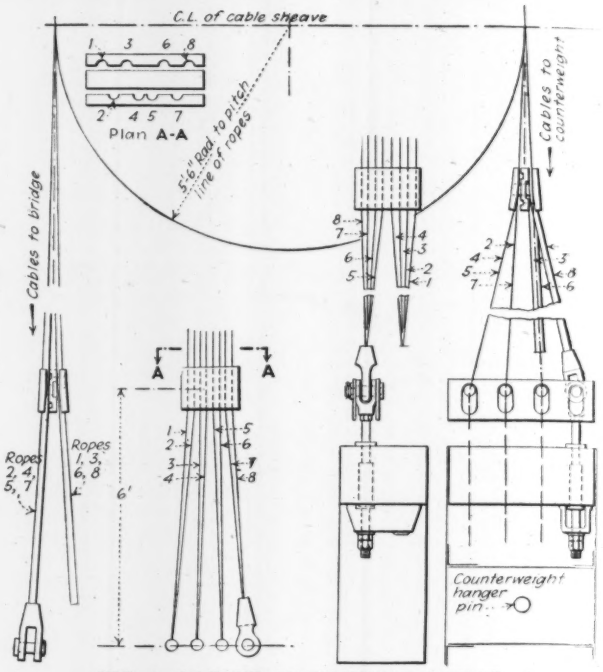


FIG. 4—LAYOUT OF HOISTING CABLES

The towers, carried by the end panels of the fixed spans, are of heavy construction to support the machinery loads. In the second panel from the top, plate-girder struts are used. In case of repair or renewal of cables or cable attachments, heavy I-beams can be laid across these struts (see Fig. 2) and the bridge raised slightly so as to land the counterweights on these I-beams and release the cables from their loads. For convenience in inspection and maintenance of the machinery, stairs instead of ladders are provided on the towers, and these stairs have solid treads of concrete.

Hoisting Cables and Attachments—The total weight of the lift span is about 361 tons, and the lifting machin-

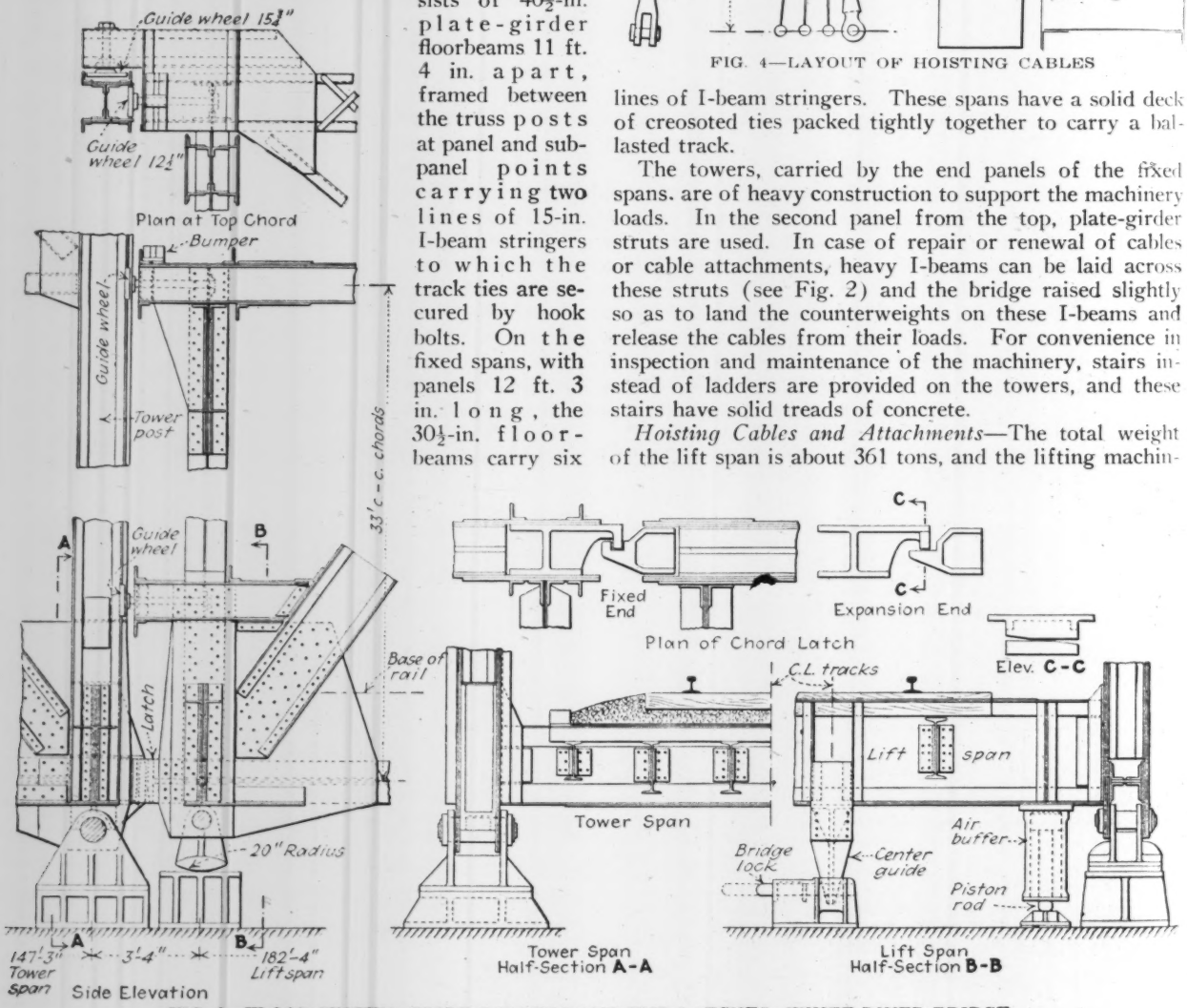


FIG. 3—FLOOR SYSTEM, GUIDE ROLLERS AND END LATCHES: WHITE RIVER BRIDGE

ery is designed for a load of 360 tons. Plow-steel cables $1\frac{5}{8}$ in. in diameter and having an ultimate strength of 220,000 lb. per sq.in. are used, with eight cables for the 90-ton load at each corner of the span. Extending up

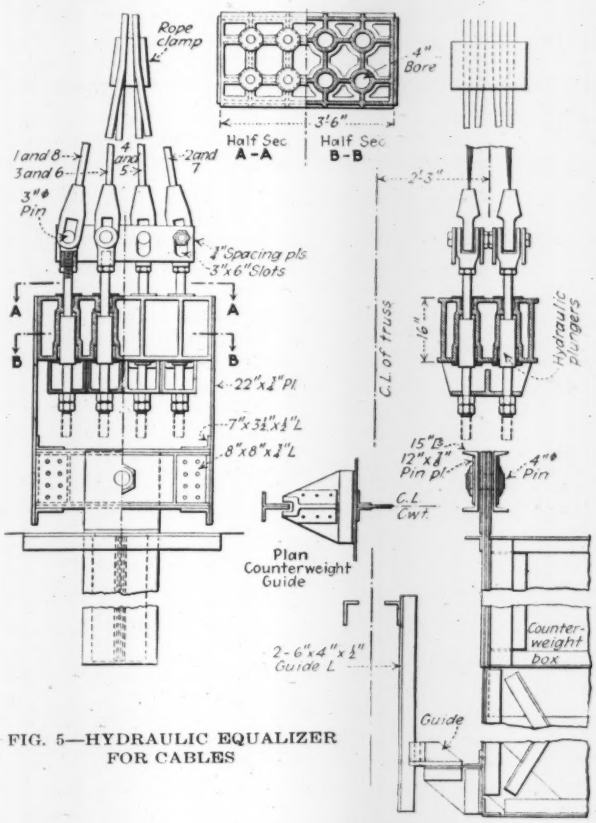


FIG. 5—HYDRAULIC EQUALIZER FOR CABLES

from the attachments to the span, the cables pass over 11-ft. sheaves on top of the towers, engaging half their periphery, and than pass down to the counterweight attachments, as shown in Fig. 4. About $1\frac{1}{2}$ revolutions of the sheaves are sufficient to give the maximum lift of 55 ft. Each sheave has a $12\frac{1}{4}$-in. face grooved for the eight ropes. At one edge of the rim is bolted a cast-steel operating gear or circular rack. The sheaves are keyed upon $11\frac{1}{4}$-in. shafts.

At 6 ft. above the lifting girder on each end of the span a clamp is fitted over the eight parallel cables, and below this they are spread to give room for the attachments. On each end of the girder is a pair of connection plates which extend above its top and have holes for 3-in. pins. The cable sockets or clevises have forked ends which straddle the plates and are secured by the pins.

The sixteen cables hanging in each tower carry a counterweight weighing about 180 tons. This counterweight, Fig. 5, consists of a structural steel box filled with concrete and old rails and having pockets on top for reinforced-concrete blocks of 402-lb. weight, by means of which the exact balance is adjusted. The balance is such that normally the span will hang in any position without the use of a brake, and power must be applied to lower as well as raise it. The counterweight moves in guides attached to the tower framing.

Tension Adjustment—Tension on the eight cables at each corner of the span is equalized by means of a hydraulic adjusting device, Fig. 5, which forms the direct attachment for the rear ends of these cables. Hangers from these devices are attached to the counterweight box by 4-in. pins. From a clamp about 6 ft. above the adjusting device, the cables are spread to their attachments.

This adjuster consists of a steel casting in which are bored chambers for eight 4-in. vertical inverted plungers. Each plunger has a $2\frac{1}{4}$-in. extension or piston rod at each end, passing through glands in the top and bottom of the casting. The upper piston rod has a forked end, which receives the flattened tail of the cable socket, and holds it by a 3-in. pin. A pair of spreader plates engages each set of four pins, so that the pull on the rods will be directly vertical, in spite of the spread of the cables. Below the plunger, the bottom piston rod passes through a hood or lug and has its end threaded to receive nuts.

Piping connects the eight cylinders or oil pressure chambers so that pressure from a pump is applied equally to all the plungers. With the cable attachments completed and the span raised slightly to put a load on the cables, a pump was operated to apply pressure in the cylinders. Then any slight slackness in tension of any one cable was taken up by a downward movement of its particular plunger. While thus under pressure the nuts on the plunger rods were screwed up tight, the lock nuts also were screwed home and then the threads of the rods slightly upset by hammering.

In case of removal of a cable or its attachments, the nuts can be removed and the plunger slackened. With the repairs completed, the tension will again be equalized by means of the pump, as described.

Operating Machinery—Four sets of operating ma-

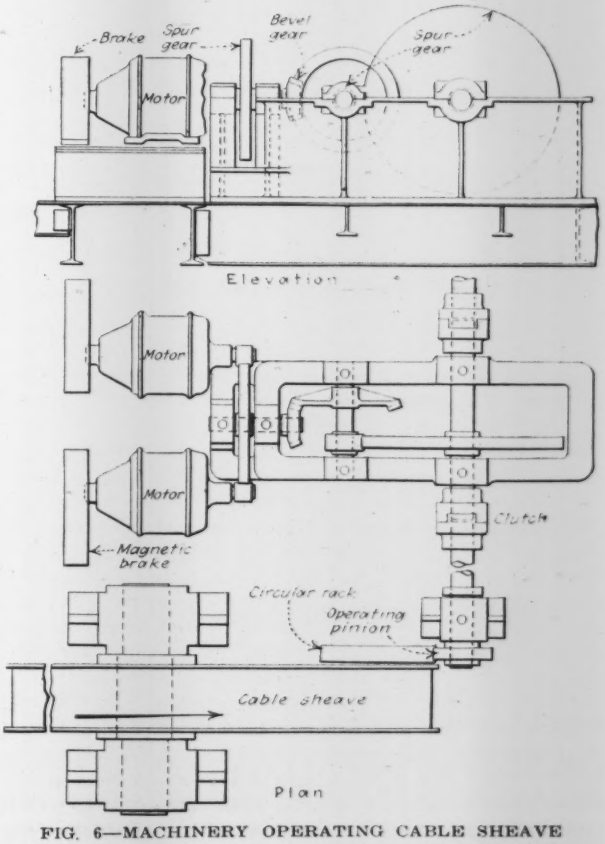


FIG. 6—MACHINERY OPERATING CABLE SHEAVE
This is one of four sets, one set for each corner of the lift span.

chinery are mounted on the tops of the towers, one set for each corner of the lift span. Each set, Fig. 6, has two 25-hp. electric motors geared to a spurwheel, but normally only one motor is in service, the other being in reserve. From this spurwheel is driven a train of bevel and spur gears, the final shaft of which is connected by a clutch to the shaft of the operating pinion which engages the circular rack or gear on the cable sheave. A magnetic brake on each motor is operated automatically, but can be applied independently from the operating cabin in case of emergency.

This cabin, carried by brackets on one of the fixed spans, just above the track level, contains all the con-

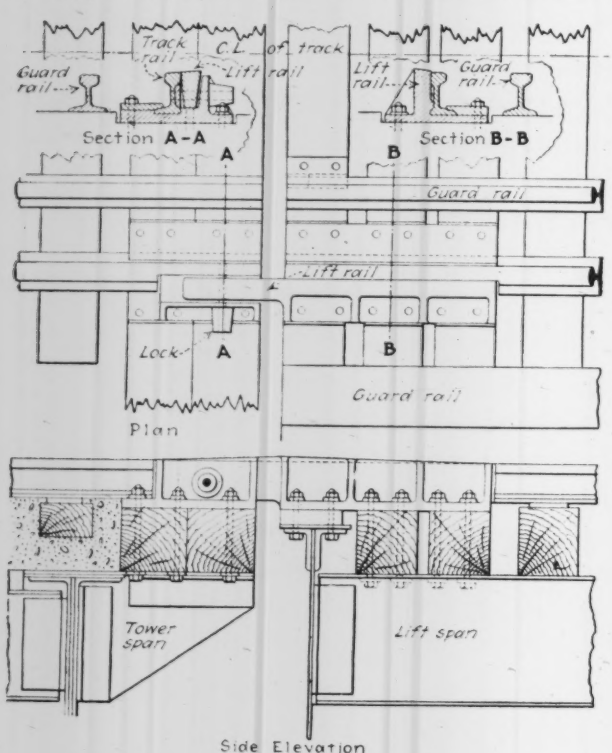


FIG. 7—LIFT-RAIL AND LOCK

trolling apparatus for the operation and adjustment of the bridge. Since the hoisting arrangement permits slight variations in travel of the two ends of the span, the controlling apparatus includes provision for adjusting any variation in level as the bridge comes down upon its seat.

Thus, by the movement of a lever in opposite directions the motors at the opposite ends of the bridge are checked or speeded up to adjust the level, as shown by indicator lights in the cabin. On this indicator a red light is shown when the rising span is nearing the top of its travel and a green light when it is in the full open position. As the bridge is lowered, a red light indicates its approach to the seats, so that the operator can control the level. Two white lights show when both ends are fully seated. Current is taken from a 13,000-volt transmission line and changed to 400-volt current by a transformer at the bridge.

Locks and Rail Connections—As the lift span comes down upon its seats, a vertical taper plunger under each end floorbeam enters a socket on the pier, thus bringing the span into the exact center line. A bolt lock through the socket and plunger is interlocked with the apparatus operating the signals on the approaches (see Fig. 3).

Under each end floorbeam also are two compressed-air buffers consisting of vertical inverted cylinders 10x24 in., with 4-in. piston rods. When the bridge is raised, the pistons fall to the bottoms of the cylinders, air entering at the tops through check valves. In closing, as the ends of the rods come in contact with castings on the pier, the further descent of the span forces the pistons upward, compressing the air in the cylinders, whence it escapes slowly through adjustable needle valves. The two buffer cylinders at each end are equalized, so as to adjust any slight variation in the level of opposite corners of the span as it comes down to its seat.

Similar buffers attached to the framing at the top of the towers are struck by bumpers on the lift span as it reaches the upper limit of its travel. Current is cut off automatically when the span is within a short distance of either limit, the final movement being then effected and controlled from the operating cabin.

During its travel, the lift span is steadied both laterally and longitudinally by idler wheels, $12\frac{1}{2}$ and $15\frac{3}{4}$ in. in diameter, with $1\frac{1}{4}$-in. face, riding in guides on the tower posts, as shown in Fig. 3. Just above each bottom chord, a short horizontal member carries a wheel fitting between guide angles on the channel face of the post. Extensions of the top chords carry wheels in the same guides, and also wheels riding in guides on the outside of the posts. The play between wheel and guides is about $\frac{1}{2}$ in. on each side.

When the span is seated, hook latches (see Fig. 3) engage between the ends of the bottom chords of the fixed and lift spans, holding them in line.

For the end rail device, Fig. 7, spanning the 4-in. gap between the rails of the lift and fixed spans, the outer side of the head of each track rail on the lift span is planed away to fit a casting which is bolted to the ties and projects over into the fixed span. As the bridge is seated, this projecting end enters a socket in a similar casting on the fixed span. The top of the former casting is cambered so as to be slightly above the rail head. As a wheel passes, the outside of the tread engages this casting and rides on it across the gap between the track rails. Provision is made for future installation of bolt locks passing through the end-lift rails and the castings on the fixed spans.

Engineers and Builders—This new system of lift-bridge operation was proposed by I. L. Simmons, bridge engineer of the Chicago, Rock Island & Pacific Ry., and the details were worked out conjointly by the engineering departments of the railroad and the American Bridge Co. The steelwork and machinery were furnished by this company, while the Kansas City Bridge Co. handled the erection, which was in charge of B. Matheis, chief bridge inspector of the railroad. Both the design and construction were under the supervision of Charles A. Morse, chief engineer, Chicago, Rock Island & Pacific Ry. The bridge was put in service on Jan. 1, 1927.

Fire Resistance of Brick Walls—a Correction

In the article, "Fire Resistance of Brick Walls," *Engineering News-Record*, Oct. 20, p. 628, in the table, the words under "Solid Walls" reading "8-in. unplastered" should have been raised one line higher. Also under "8-in. 'Rolokbak'" the resistance period corresponding to "Combustible; hollow spaces at floor line filled" should be 4 hr. instead of 9 hr. as given in the table.

Sewer Tunneling by Day Labor at St. Paul, Minn.

Practice Governing Day Labor Work—Methods and Cost of Driving and Lining 8-ft. Tunnel In Hazardous Ground

By William N. Carey
Superintendent, Bureau of Construction and Repair, Department of Public Works, St. Paul, Minn.

THE charter of the city of St. Paul requires that the city shall ask for bids on work of public improvement for which a direct assessment against abutting property is to be levied. Most public improvement work here is, therefore, done by contract. At every letting the city engineer, through the Bureau of Construction and Repair, submits an estimate of cost. The estimate is not made public until the bids are about to be opened, and is in effect the city force-account bid. Usually, if the lowest contract bid is under the final estimate, the work is awarded to the low bidder. If, however, the final estimate is lower, the city council usually directs that the job be done by city force-account. During the past three years, 1924-1926 inclusive, the city has spent about $6,000,000 on sewer construction, approximately $5,600,000 of this being for contract work and only $400,000 for force-account work.

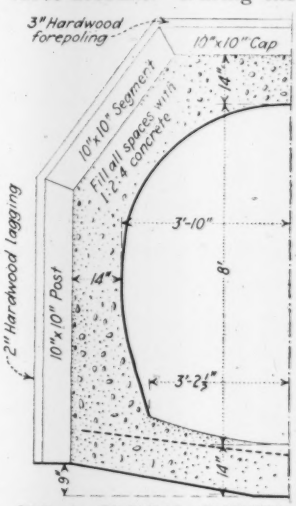


FIG. 1—TYPICAL TUNNEL TIMBERING AND LINING

The Department of Public Works has adequate paving plant and sewer plant equipment, together with the necessary key men, so that the construction bureau can go forward promptly with any work which may be assigned to it. The ability of the city to perform promptly and economically any work of public improvement acts as an excellent safeguard against too high contract prices, but it often results in the construction bureau getting the "tough" jobs. The prudent contractor takes into consideration in his bid the element of risk, and, where the risk appears high, he bids accordingly. This was so in the sewer work here described which is Section B of the belt line sewer described in *Engineering-News Record*, May 10, 1927, p. 812. It was advertised three successive times and finally the council directed that it be done by force-account.

The bulk of the work on Section B of the belt line trunk was 7-ft. and 8-ft. horseshoe section, 6,000 ft. in length; 2,200 ft. of the 8-ft. section was in a single tunnel. This tunnel followed the center line of three well-built residence streets and its invert was about 50 ft. below the surface. The hazard existing in the construction of this tunnel undoubtedly caused the contractors to submit high bids.

The city's estimate on Section B was $328,000. The lowest bid received on advertising three successive times was $348,000. With 2 per cent of the contract price added to cover inspection the amount to be assessed was $354,960. On force-account work, no inspection charge as such is made, but all field engineering inspection, overhead and supervision is charged directly to the job. The wide difference between the estimate of probable cost and the amount which had to be assessed in case a contract was let probably was the governing reason why the city council decided to assume the presumed hazard in the job and to do it by force-account.

Costs were kept. A bookkeeper thoroughly familiar with construction work was on the job from the first day. An accounting system to fit the work was decided upon before the job started, and though it was found to be not perfect it remained in force throughout. In addition to the field cost office, all accounts had to pass through the hands of an expert accountant at the office of the commissioner of public works and from there through the office of the city comptroller. If ever there was a force-account job more closely checked and double-checked as to costs the writer has not heard of it. For various reasons, the books on this job have not yet been closed. There still remains some $10,000 worth of equipment to be sold and credited to the job.

As near as we can determine it now, the cost of the Section B under city force-account is $354,000. The contractors were right in assuming that there was a construction hazard in the tunnel. We found it. Our costs show it. Although no great saving resulted in doing this work by force-account rather than by contract, the decision for force-account appears to have been amply justified in that it permitted the department of public works to demonstrate for the first time that it could carry out a job of this kind and size efficiently and expeditiously. This fact is especially valuable to the city at this time, in view of the pending passage of orders to construct the $2,250,000 Kittsondale sewer system in which there are about three miles of large tunnel.

TABLE I—SEWER TUNNEL COST: ST. PAUL, MINN.

Tunnel size (inside of timbers)	10 x 10 ft. 4 in.	
Length constructed	2,200 ft.	
Material encountered	Glacial drift (wet)	
Depth of shafts	42 ft. (average of 3)	
Concrete per foot, cu.yd.	1.7	
Inside size of sewer	7 ft. 7 in. x 8 ft.	
Type of sewer	Horseshoe	
Type of forms	Steel	
Method of placing concrete	Hand labor	
Tunnel constructed by	City force-account	
Cost data obtained from	Actual cost record	
Labor Driving	**Per Lin. Ft.**	
Mining and timbering	$19.97	
Muck disposal	12.00	
Miscellaneous surface labor	3.51	
Pumping	0.78	
Total labor		$36.26
Timber		8.04
Equipment rental		4.84
Total cost tunnel driving		$49.14
Lining	**Per Lin. Ft.**	
Labor	$12.15	
Materials	9.90	
Concrete forms	0.41	
Equipment rental	1.02	
Total cost concrete lining		$23.48
Average cost per cu.yd. concrete	$13.80	
Total cost per lin. ft. of completed sewer (barrel only)		$72.62

Mining and Timbering—A half-section of the 8-ft. tunnel is shown by Fig. 1. The material was glacial drift, which varied from a solid red clay containing a few boulders to clean, fine sand; it included about all of the possible combinations of clay and sand between these two limiting classifications. There was comparatively little extremely wet work but about 75 per cent was wet enough to require constant vigilance and caution, and to

require immediate support on account of extremely heavy pressures on forepoling, lagging and timbers. Runs of thin mud or fine sand had to be checked as soon as they started. Such material was held back by calking behind and between forepoling, by lagging and by breast-boards packed with wild hay, a good supply of which was always kept at hand, near the faces.

The excavation for the 8-ft. section was finished

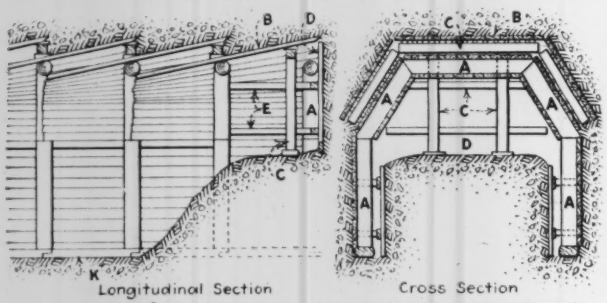


FIG. 2—TYPICAL DRIVING AND TIMBERING METHODS

10x10½ ft. inside the timbers. As the timbers averaged 9 to 10 in. in diameter, this gave an actual section to be mined about 12x12½ ft. Five-piece sets were used, as shown by Figs. 1 and 2. Forepoling of 3-in. hardwood, fanned out so as to make the outside corners tight, was used over the caps and segments of the sets, with 2-in. hardwood lagging outside of the posts. The Norway pine sets were spaced 4 ft. 10 in. c. to c. and were spragged with 6-in. tamarack. The sills were 8x10 in. in lengths of 4 ft. 10 in., with no cross spaces between them. Mining, mucking and tramming were done by hand. Large capacity steam pumps were operated continuously from the boilers operating the hoists. Costs on mining and lining for these tunnels are shown in Table I.

The problems involved in tunneling through the type of glacial drift encountered here are not new. The mining methods used have been used elsewhere and especially on the Iron Ranges of Minnesota for many years. For the timbering, heavy sets about 5 ft. c. to c. were framed, with forepoles driven either with or in advance of the heading, about as shown in Figs. 2 and 3. Fig. 2 shows the tunnel immediately after the set *A* has been placed. The forepoling *B* is supported by the temporary cap and posts, *C*, and the breast-boards *D* are braced back against the preceding set by braces, *E*. For the next operation, the longitudinal section in Fig. 2 indicates the transfer of the support of the forepoling to the new set *A*. This is done by placing the transverse timber, *F*, shown in section *X* on Fig. 3, directly above the cap and blocking up between the boards and cap. The blocking between the timber, *F*, and the cap, *A*, is of such thickness that the opening left will permit the entrance of forepoling, *B*. The center breast-board is then cut through by drilling and the forepoling driven a short distance.

A portion of the breast-board is then removed and the earth under the forepoling excavated. Other forepoles are introduced in a similar manner on each side and the excavation is widened and deepened. As soon as the excavation has proceeded to such a point that the forepoles require support, temporary posts, *C*, are placed, as shown in section *Y*, Fig. 3. In sand there may be several sets of temporary posts used. Short posts are then replaced progressively by longer ones as widening and deepening the heading proceed. Where the soil will stand up for a short time, the entire face to about a man's height is dressed down before placing breast-boards, while in clay no breast-boards are required. In sand, small breast-boards must be placed as soon as the face is reached and these must be gradually replaced by larger boards, as the face is widened and deepened.

Three forepoles on each side of the top, and eight along each sloping side, are made fan shaped, so that they will completely retain the earth as the area widens out. In section *Z* of Fig. 3, a transverse view of the heading, the left half shows the appearance after all the forepoling has been placed. In the next operation, shown on the right of section *Z* in Fig. 3, a trench is carried downward and progressively sheeted by boards, *G* and *H*, braced by struts, *J*, until the sill, *K*, can be placed. After both sills have been set, the posts, segments and cap of the new set of timbers are placed. Mining was carried on 24 hours daily, in three 8-hour shifts.

Tunnel Lining—No unusual plant or methods were used in lining the tunnel with concrete. In the 8-ft. horseshoe, hand labor was used throughout, as the small interior section practically prohibited the use of concrete-placing machinery. Concrete was mixed on the surface and chuted down the shafts into a hopper suspended from the timbers in the tunnel. In pouring the invert, end-dump cars of 12-cu.ft. capacity, running on a 24-in. track, carried the concrete in the tunnel from the hopper to a steel shoveling plate from which it was shoveled into

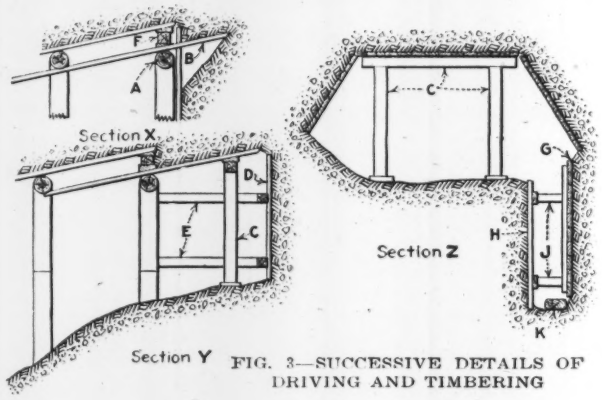


FIG. 3—SUCCESSIVE DETAILS OF DRIVING AND TIMBERING

place in the invert. Wheelbarrows were used for carrying all concrete for walls and arch.

Three 25-ft. lengths of collapsible steel forms were used for the arch lining. A night crew moved one section of forms ahead each night, so that two places for depositing concrete always were available. The side walls of the first section of forms were poured at the same time that the arch of the second or middle section was poured. The concrete of the end or third section, which had been poured the preceding day, was thus given ample time to set. Two men were kept behind the forms shoveling and ramming the concrete back, so that all the spaces between the form and the tunnel timbering were filled completely. Had the sections been larger or had the tunnels been longer, more elaborate concrete placing plants would have been warranted. As it worked out, the use of hand labor for practically all of the concrete placing was found to be good economy. In no case were both tunneling and concreting carried on simultaneously in the same tunnel.

Shaft Sinking—Three timbered shafts were sunk. The shaft timbering (Fig. 4) was suspended from two heavy bearing timbers at the surface by means of suc-

cessive bolts. Excavation was carried down by using 1-in. pine backlath of varying lengths. The excavation for each backlath was closely followed down with the

TABLE II—TIMBERED SHAFT SINKING COST: ST. PAUL, MINN.
As sunk by city force-account during the year 1926

Number of shafts sunk	3
Average depth of shafts	42 ft.
Size of shafts (inside of timbers)	10 x 7 ft.
Material encountered	Glacial drift (sand, clay, water)
Size of timbers	10 x 10-in., 2-in. lagging, 1-in. backlath
Method of sinking	Packlath method
Hoisting	Buckets hoisted by steam hoist
Muck disposal	Cars and track, 500-ft. haul
Spacing of sets	4 ft. c. to c., hung with hanging bolts
Cost obtained from	Actual cost records

AVERAGE COST PER FOOT OF DEPTH

Labor		
Mining and timbering	$13.19	
Hoisting and muck disposal	8.23	
Miscellaneous surface labor	5.55	
Total labor		$26.97
Timber		8.14
Material and supplies		3.91
Equipment rental		3.07
Total cost per foot of shaft sinking		$42.09
Cost per cu.yd. of shaft, including timbering	$10.52	
Cost per cu.yd. of shaft, excluding timbering	6.90	

point of the lath until the top of the lath cleared the 10x10-in. timbers of the last preceding set. The top of the backlath was then slipped behind the set timber and pried upward behind that timber to its permanent position, as shown in Fig. 4. The lagging, 2-in. hardwood placed vertically, was then set up inside the backlath and the posts and timbers for the new set were placed. Wild hay was freely used behind the backlath to prevent runs of sand and mud.

Indicating the success of the method, one of the shafts was sunk without difficulty through a 13-ft. stratum of fine water-bearing sand, which could almost be classified as quicksand. The costs of sinking these three shafts are given in Table II.

Engineers—All this work was done according to

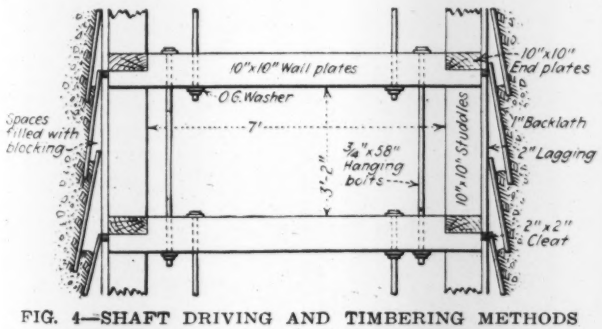


FIG. 4—SHAFT DRIVING AND TIMBERING METHODS

standard plans of the Department of Public Works, of which J. H. McDonald is commissioner, and George M. Shepard is chief engineer. Cost information was obtained and tables of costs were compiled by C. R. Raiter, assistant superintendent of construction, who was resident engineer. The construction was under the immediate supervision of the writer as superintendent of the Bureau of Construction and Repair for the Department of Public Works, St. Paul, Minn.

Road Concrete and Workmanship Control in South Carolina

Concrete Proportioned by Weight with Moisture Correction for Aggregates and Core Tests for Strength and Thickness

By E. D. Sloan, Jr.
Division Engineer, South Carolina State Highway Department, Columbia, S. C.

As an illustration of certain rather unusual methods of construction of concrete pavements in South Carolina, a brief description is given of a federal-aid project 38-C which extends from Clemson College to a point about one mile north of Seneca, traversing 8½ miles of the foothills of the Blue Ridge Mountains. Approximately 3.4 miles of the project is along an old railroad bed, 3.6 miles is along previously graded and selected soil-surface road; and the remaining 1.5 miles is along new locations. Two cross-sections of pavement were used. Where the project followed closely the alignment and grade of the old railroad bed or the old soil-surfaced road, the section used was 7-5½-7 in., both the finished surface and subgrade having a 2-in. parabolic crown. On new location and where subgrade conditions were not good, the section used was 8-6½-8 in.; in this case also, both surface and subgrade had a 2-in. parabolic crown. Approximately 30 per cent of the yardage was of the 8-6½-8-in. section; and the remainder of the thinner, or 7-5½-7-in. section. The contract prices per square yard were $2.29 and $2.14, respectively.

Deep Fills Paved—Approximately 800 lin.ft. of the pavement was on two new heavy fills, one being about 20 ft. in height, the other about 30 ft. Apprehension of settlement was felt for these places, even though the fills were of good quality clay and had been carefully built up in horizontal layers about 1 ft. in depth and each layer rolled with a 10-ton roller. Decision had to be made as to whether or not it would be most economical and to the best interest of the traveling public to place the pavement on these at once, or to wait and allow them to settle for a time before the pavement was laid. It was decided that the pavement should be placed at once. The reasons for following this plan were:

The 800 lin.ft. or 1,600 sq.yd. of paving would cost $3,664 at the contract price of $2.29 per square yard. To re-let this small yardage at a later date would cost around $2.75 per square yard, or $4,400. To this amount should be added the cost of surface treating the 1,600 sq.yd. omitted, at an estimated cost of 30c. per square yard, a total of $480, giving a grand total cost of $4,880 as the cost for placing the 800 lin.ft. at a later date. Subtracting the actual cost under the original contract from this amount gives $1,216 as available for repairs or any replacements that might be required. This amount is sufficient to pay for the repaving of over 400 sq.yd., and it is not thought that the replacements will run that high. A favorable feature, in the case of the height of these two fills, is that a long vertical curve centered over the highest part of the fill, which would lessen the bad appearance of any settlement.

Proportioning by Weight—The proportions used for the concrete were equivalent to a 1:2:4 mix, measured by loose volume. The measuring was, however, done by weight. The specifications covering this feature read:

The concrete shall be in the proportion of 94 lb. of cement to 540 lb. of combined, dry, fine and coarse aggregate. The proportion, by weight, shall be approximately 94 lb. cement to 170 lb. sand to 370 lb. of crushed stone. These weights are based on a specific gravity of 2.65 for the coarse and fine aggregates. Any variation from this figure will be cared for by making suitable adjustment in the weights actually used in proportioning. When the aggregate is wet an allowance shall be made in the weights used to compensate for the moisture contained in the aggregate. The ratio of fine aggregate to coarse aggregate may be varied by the engineer in order to obtain concrete of maximum density and strength, the total weight of aggregate used to a bag of cement being kept constant.

Moisture determinations were made every day or so on samples of sand taken from the stock pile, the samples being taken sufficiently often to prevent any appreciable variation in the amount of sand used in the proportions. The determination of the moisture correction is a simple matter and takes but a few minutes. The method followed was to weigh out 100 grams of the sand, drive off the moisture by heating, then weigh again; this final weight represents the percentage of dry sand in the sample. Dividing 170 by this figure gives the weight of moist sand to be used per bag of cement, for setting the scales. The moisture content of the crushed stone showed only small variations, and one or two moisture determinations should be sufficient, for the crushed stone, on the average size job. The writer strongly recommends the proportioning of the aggregates by weight. The increased accuracy and uniformity secured are desirable from both the engineer's and the contractor's standpoint.

Depth and Strength Checks—Line and grade stakes were set for each form. The fine grading was done several hundred feet ahead of the mixer; and the accuracy of this work checked by a subgrade templet pulled between the concrete and the mixer. This templet as well as the strike-off screed were checked as to crown every day. In addition to this precaution for getting full specified thickness, the instrumentman secured accurate cross-sections of the subgrade at about 1,000-ft. intervals just ahead of the concrete; and established a base point on each side of the road. After the concrete was placed and had taken its final set, a second set of cross-section levels was taken over the finished surface at the identical ordinates of the first set; and the thickness of the concrete at the several points computed. A permanent record was kept of these cross-sections, and copies sent to the division and main offices. These reports show the over-run or under-run in thickness at the different points, and the average over-run or under-run in thickness for each cross-section. Incidentally, they also give a check on the crown being obtained. The readings are taken at 3-ft. intervals and read to a thousandth of a foot. A further check on the thickness is obtained from cores drilled from the pavement at about 500-ft. intervals. Thirty-eight cores taken from four miles of this project showed an average over-run in thickness of 0.056 in., with only slight variations for each core. Tests made on these cores showed an average compressive strength of 3,780 lb. per sq.in., at an average age of 71 days, the strength being adjusted to correspond to that of test cylinders in which the ratio of height to diameter equals two. The cores were broken in a dry condition.

Field-cast specimens of the concrete are made in sets of three 8x16-in. cylinders for about every 1,500 lin.ft. of pavement. These cylinders are kept moist and are forwarded to the department's testing laboratory when about two weeks old. Tests made on these cylinders showed an average compression strength of 2,600 lb. per sq.in. at 28 days. These cylinders were broken wet, in the standard manner.

Finishing Procedure—The finishing was done with a finishing machine, followed by rolling and belting. Transverse expansion joints were installed at 40-ft. intervals; and the finishing was made continuous over them. A metal header board was used, made from a $\frac{1}{4}$-in. plate on the top of which was riveted, with countersunk rivets, a $1\frac{1}{2}$x$1\frac{1}{2}$x$\frac{1}{4}$-in. angle. The cross-section of the header board corresponded exactly to the cross-section of the pavement, but with $\frac{3}{4}$ in. cut off each end. The function of the angle on top is largely as a stiffener, although in use the overhang protects the top of the prepared joint. The prepared joints are cut to the cross-section of the pavement, less $\frac{1}{4}$ in. in depth. They are placed in position, with the board on the mixer side, and the joint on the concrete side under the overhang of the angle. The board is held in place by four to five iron pins driven on the mixer side of it, and three on the concrete side; all pins being driven slightly below the level of the finished surface. Concrete is then laid and finished continuously over the joint. The slight excess crown required in the finishing machine screed, to allow for settlement in the concrete, permits it to pass on over the header board easily. When the finishing machine has passed to a little over half the length of the next slab, the pins are pulled from around the header board by a man from the bridge, and the header board is then taken out and carried forward to the next joint.

After rolling and belting, the joint finishers, with a brickmason's trowel, spade on both sides of the joint and correct any leaning it may have assumed. It is sometimes necessary to throw in a shovelful of concrete to fill up space vacated by the header board. To insure a smooth uniform surface, the joint is then floated with a 10-ft. straight-edge. The top of the joint is $\frac{1}{4}$ in below the surface. After the concrete has taken its initial set, the finishers edge both sides of the joint with an edge-tool of about $\frac{1}{2}$-in. radius. The next day, before covering with dirt for curing, the small amount of mortar left on top of the joints between the edging tool lines is scratched off. This has proved to be a satisfactory manner of joint installation whether a finishing machine is used or not; and the chances of getting a smooth surface at the joints are better than with the old system of leaving the joint 1 in. above the surface. It is only a matter of a few months until the joint material is compressed out to fill the joint space to the surface. A 10-ft. straight-edge passed over the pavement surface on this project reveals very few places where the variation is over $\frac{1}{8}$ of an inch.

The contractor was the Simons-Mayrant Co. of Charleston, S. C., with C. E. Page, superintendent, C. B. Ramsaur, resident engineer.

Official Vote on N. J. Zoning Amendment

According to official figures, the zoning amendment voted on in a special election in New Jersey on Sept. 20 was adopted by a majority of 207,237. In *Engineering News-Record*, Sept. 22, 1927, p. 485, the figures given did not include the vote in 150 precincts, which at that time was missing. The total number of votes cast was 396,383, representing a very light vote out of a total registration of over one million.

Altering a Meat-Packing Plant While in Operation

Part of Old Timber Framing Rebuilt in Metal and Concrete—Methods of Handling Construction and Operation

By M. J. Hess
Assistant Engineer, T. M. Sinclair & Co., Ltd.
Cedar Rapids, Iowa

RECONSTRUCTION of the hog cutting room on the third floor of a meat packing plant, without interrupting the work of cutting up hogs at the rate of 500 per hour, was a rather complicated job carried out successfully at the plant of T. M. Sinclair & Co., Ltd., Cedar Rapids, Iowa. Owing to its necessary proximity to the existing hog chill rooms, it was desirable to build the new cutting floor in the same location as the old one. That meant building, into an old three-story structure of wood post and frame construction with brick walls, a modern fireproof and sanitary cutting floor at a level between the original second and third floors. To add to

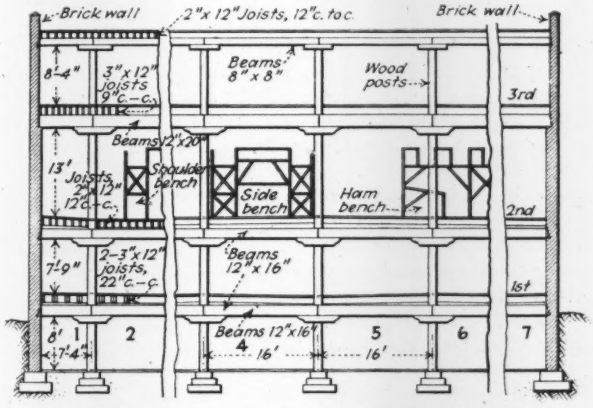


FIG. 1—TYPICAL ORIGINAL TIMBER FRAMING

the complications, government inspectors were on hand to see that rubbish was cleaned up promptly and that sanitary conditions were maintained.

In packing-house operations, the cleaned and split carcasses of the hogs are hung in a cooler for 24 to 48 hours to remove the body heat. When properly chilled, the carcass is taken to the cutting floor and cut into various portions which are then processed in different departments.

Two general types of cutting floors are in use in modern plants: (1) The insulated and refrigerated room, and (2) the room in which a comfortable working temperature is maintained but the product is carried through in as short a time as possible. The first type, by keeping the product chilled, retards bacterial action and maintains the product in a firm workable condition. The second type tends to make working conditions more suitable, consequently influencing the workers to more careful and painstaking work. The meat does not gain enough heat in its brief journey through the room to noticeably affect the quality, an actual raise of only two degrees being experienced. The latter type of room was decided on after careful study and inspection of other plants.

In the original timber construction, shown in Fig. 1, it is of interest to note that although the structure was built in 1873, some of the original white-pine girders removed were as sound and firm as if new. This preservation was due in part to the fact that the timbers were kept continually damp by reason of the curing vats located in the basement.

The altered construction as now completed, is shown in Fig. 2. The new floor, which is L-shaped, consists of a reinforced-concrete slab carried on steel I-beams and supported on cast-iron columns extending down to the old footings. The columns in the top floor support steel roof trusses with pyrobar gypsum roofing which gives a paneled ceiling effect. An 8-in. brick wall, faced on the inside with buff salt-glazed brick, encloses the room up to the level of the old roof, above which the walls are of steel sash with pivoted panels for ventilation.

The first step in the reconstruction was the replacement of the wooden posts with the cast-iron columns. The columns were cast by a local concern and delivered on the job in the sequence in which they were used. In order to avoid any interference with the regular packing operations, this work was done mostly at night. When the new columns were in place they took up less room than the old ones, and consequently they are no hindrance to the workmen or machines. As soon as the columns were carried through to the roof, the new trusses were erected, the roof placed and the windows hung. The roof slabs are supported by T-bars welded to the purlins. Part of the welding was done by oxy-acetylene torch and part with an electric welding machine. They were welded partly with the idea of saving time, but mostly as an experiment, with the purpose in view of welding small structural jobs around the plant. The results of this work were very satisfactory.

Due to the construction of the building it was necessary to remove an entire line of timber columns from basement to roof before replacing them with the cast-iron columns. Screw jacks and heavy timbers were used to take the load off the old posts. Two screw jacks were used on each side of the posts under the girders. The jacks were turned simultaneously and the load lifted from the post cap, starting in the basement and taking each floor in succession to the roof. When the load was all taken by this shoring, the line of posts was removed and the columns were slipped into place. The cast-iron columns were placed by a local iron worker, who took them to their respective floors on the packing plant elevator and rolled them adjacent to their final location. As each floor was reached, it was then only necessary to raise the columns to an upright position with a chain hoist suspended from the floor above and drop it into place.

It was necessary to cut holes 3 to 5 ft. long in the floors, at right angles to the girders and between the joists, in order to straighten the columns to their proper place. The bases were leveled with a very dry cement mortar tamped into place on top of the old footings. When one line of columns was in place, it was plumbed and braced in place at each floor. The outside columns were placed first, so that the roof trusses could be erected while placing the middle columns was being carried through. As fast as consecutive columns were placed, the I-beams joining the columns around the edge were placed. The beams supporting the floor were not placed, of course, until the columns of the middle row were in place. Then only half of the beams were placed and the

floor was poured to avoid interference with the cutting floor operations, as explained later.

A covered loading dock along the north side of the building facilitated the location of the concreting plant. A wooden tower was erected against the wall of the building and through the roof of this dock. Holes were knocked through the building wall at the second and third floors to serve as temporary doors, and a hoisting platform served these two floors and the roof. When concrete was poured, a tilting bucket was substituted for the platform and the concrete was chuted through an opened window in the roof. Both the steam hoist and the mixer were located on the covered platform.

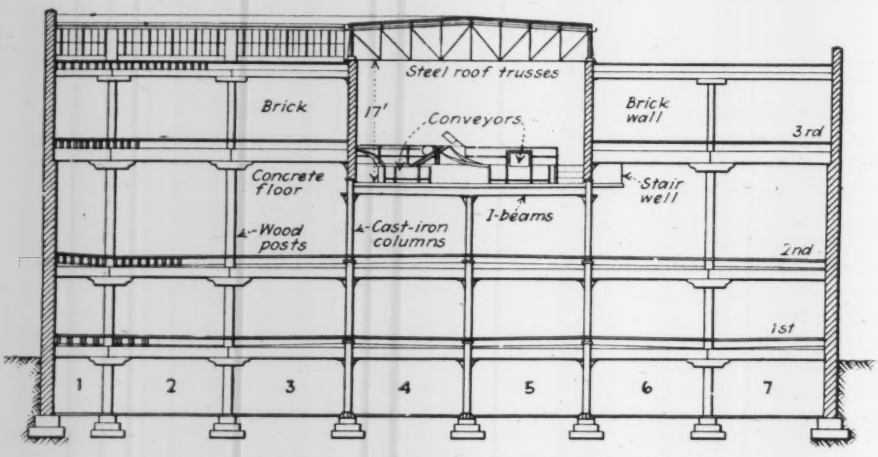


FIG. 2—RECONSTRUCTION IN OLD BUILDING

When concrete was poured, cars of aggregate were spotted along the dock, and the material was wheeled to the mixer, which was arranged to discharge directly into the tilting bucket. Hoppers were hung on the sides of the cars of aggregate, the material shoveled from the cars into the hoppers and then dumped into the wheelbarrows in batches. During freezing weather the aggregate and the water were heated with steam coils run from the steam main in the building. The hoist also was operated by steam from this main.

The hoist was utilized to raise the trusses to the roof. A boom was extended several feet out from the top of the tower and the hoisting cable was run over a pulley on the end of the boom. The trusses were then pulled on a skid to the roof of the dock and on another skid to the roof of the building. They were moved along the old roof on rollers and as the columns extended a maximum of only 2 ft. above the roof, the trusses were lifted to place on top of the columns, one end at a time, by man power.

The window sills were cast from column to column as self-supporting reinforced-concrete beams. Cold weather had set in by this time, but with the roof on and canvas stretched from the sills to the old roof, the rest of the work was inclosed and the only other precaution necessary in pouring the slab, which was done in temperatures below freezing, was to heat the water and the aggregate.

Inside the new structure the old roof was left in place, supported by temporary brackets bolted to the new columns and by posts in the center. It was used as a scaffold both in erecting the roof and pouring the sills and for all painting, sprinkler and electrical work under the roof.

Pouring the concrete slab was done in three sections. Half of the long leg of the L-shaped floor was cast first. When it had set, the new side conveyor was erected, the old side benches were removed and the second half was poured. Forms for the slab were supported by 2x12-in. timbers resting on the lower flanges of the 18-in. I-beams. Conveyors in this cutting room, see Fig. 3, total about 200 ft. in length. Their supports and framework are galvanized and the table tops along each side of the conveyor proper are of monel metal. The upright supports were welded together instead of riveted, and were galvanized after welding, thus making a very rigid and sanitary job. Longitudinal members were necessarily bolted to facilitate shipment and assembly.

The conveyors presented a problem in pouring the slab for the short leg of the floor, as the ham slipping conveyor (see Figs. 2 and 3) was to be replaced, but could not be taken out of service for any long period. Advantage was taken of an occasion when hogs were not scheduled to be cut on Monday. As soon as Saturday morning's work was finished, this conveyor was hoisted from the roof girders with four 5-ton chain hoists and left suspended while the slab was poured Saturday night. On Monday night, the slab was planked, the conveyor lowered, a temporary drive rigged up and on Tuesday morning it was put into operation. The new conveyor was erected beside it and on another week-end was moved into place and the old conveyor removed.

Brickwork for the walls was started as soon as the floor was set and carried up to the window sills. Openings were left in the walls for unit heaters which will be used in winter to heat the room. The floor was pitched

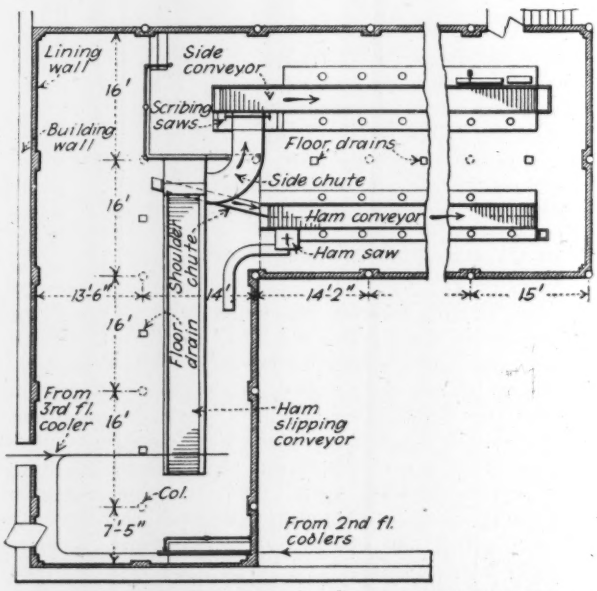


FIG. 3—CONVEYORS COMPLICATE FLOOR WORK

to the center to floor drains centrally located in each bay. A troweled mortar finish was employed on the floors and a 2-in. curb built around each of the many floor openings which were left for troughs and conveyor drives. Water is carried from the floor drains through 5-in. cast-iron soil pipe fitted with deep seal traps draining to the sewer. This method of drainage is a requirement of the United States government. The floor drains are of special design to catch as much of the scraps of fat as possible. The plant sewer runs through the general catch-basin for the recovery of fats and greases before dumping into the main sewer.

It will be seen from the drawings that the floor on which the old cutting floor was located has a high ceiling. This made it easy in most cases to protect meat and workmen from dirt and débris by erecting temporary scaffolding and stretching canvas above them. Some of the work which could not be so protected was temporarily moved to other parts of the room or of the building. Certain parts of the work, however, could neither be protected nor moved; in that case construction work was carried on either at night or when cutting operations were suspended. As a whole, very few delays were experienced on this account. Throughout the entire construction period a clean-up gang was employed to keep rubbish hauled away as fast as it accumulated and to maintain sanitary conditions.

Due to the nature of the job and the impossibility of making any accurate estimate as to labor required, it was decided to let the contract on a cost-plus basis. The contract was let to Max Mildenstein, of Cedar Rapids, with the understanding that all plumbing, electrical work, steam fitting and sprinkler work would be done by the gangs in the regular employ of the packing house for that work. Work was started in August, 1926, as soon as the preliminary plans were ready, and was finished in April, 1927. Plans were made and the construction supervised by the engineering department of T. M. Sinclair & Co., Ltd., under the direction of L. F. Prior, assistant general superintendent and plant engineer, with the writer as assistant plant engineer.

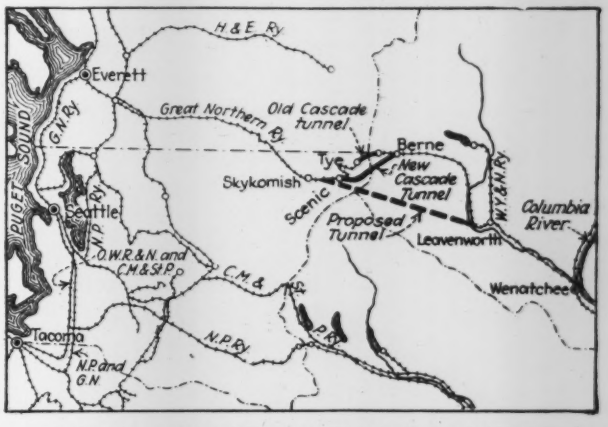
Cascade Tunnel Commission Favors Route Near Great Northern

By Frank W. Harris
Seattle, Wash.

CONSTRUCTION of twin railroad tunnels 29 miles long under the Cascade Mountains to provide a low level route for both highway and railroad traffic between the eastern and western parts of the state of Washington has been recommended by the Cascade Tunnel Commission in its report to the 1927 legislature. The report outlines possible locations for six tunnels under the Cascade range at the 1,000-ft. contour level varying in length from 29 to 68 miles, but favors the shortest of these tunnels which follows the route recommended by General Chittenden in his proposal published in *Engineering News*, Nov. 16, 1916, p. 928. This route is close to the line of the Great Northern Ry. Its approximate location is shown in the accompanying map.

The tunnel commission's report is the outgrowth of the need for some better physical connection between the eastern and western part of the state of Washington. In 1925 Judge Austin E. Griffiths organized the Cascade Tunnel Association and succeeded in getting the legislature to appoint a Cascade Tunnel Commission to report to the legislature in 1927. The commission consisted of S. A. Perkins of Tacoma, Clarence D. Martin of Cheney, and John P. Hartman of Seattle.

The problem stands today substantially as stated by General Chittenden, namely, that Puget Sound with its excellent safe harbors is hemmed in by the high mountain wall of the Cascades. The lowest passes across this great barrier are more than 3,000 ft. high and in winter the heavy snowfall makes them impassable. The only changes since General Chittenden made his recommendations have been in the electrification of the Chicago, Milwaukee & St. Paul and the start of construction by the Great Northern of its new tunnel and the electrification of its lines through the tunnel.



ROUTE OF PROPOSED TUNNEL UNDER CASCADES

In making the studies, the 1,000-ft. elevation was taken to be the most desirable location for the tunnel portals in order to keep down the grades and to avoid trouble with snow, but it appears now that there can be no great objection to building on a 1 per cent grade to portals at the 1,200-ft. elevation in order to reduce the length of the tunnel somewhat.

The commission worked upon the assumption that both highway and railroad traffic would use the tunnel, the highway traffic being transported through the tunnel on specially designed cars. It made no definite recommendations as to whether one large double-track tunnel or two single-track tunnels should be built, but stated that competent engineers advise the construction of twin tunnels about 100 ft. apart. A profile of the route shows that the project could be carried on by the use of shafts. General Chittenden's plan showed the use of three shafts, but he also considered the possibility of driving entirely from the portals.

The chief obstacle to the construction of such a tunnel is that of co-ordinating the various interests. The main support of such a tunnel must come from railroad freight tonnage, but as motor truck and pleasure vehicles also will benefit as well as the state at large, many interests must be brought into agreement before construction can be begun. The commission recommends that the work be done by the state or by a tunnel district. No estimate of the cost has been made but judging by the cost of the Moffat tunnel the cost of the proposed tunnel will be over $60,000,000.

Steel Fabricators Take Up Structural Problems and Business Co-operation

American Institute of Steel Construction Examines Various Classes of Competition—Structural Safety, Wind Stresses and Tension in Rivets Subjects of Technical Sessions—Possibilities of Steel Houses

MODERN forms of competition as affecting structural steel, and the possibilities of little known fields for light fabricated steel, were strong features of the business discussions at the fifth annual meeting of the American Institute of Steel Construction at Pinehurst, N. C., last week. Technical subjects were not overlooked. Papers on fireproofing structural steel, on safety in building construction, on tensile working stresses in rivets, practical tests of windbracing, and the economic height of tall buildings, received serious attention. Even the possibilities of a highly competitive material, reinforced concrete, were considered.

Association Activities—A review of the general activities of the institute showed that adoption of its standard specification for the design, fabrication and erection of structural steel by cities throughout the country has increased considerably during the year. Rapid progress also was made in adoption of the institute's code of standard practice. Work on its handbook has progressed to the point where it is expected that it will be ready for distribution some time in November. Its specifications for fireproofing structural steel were distributed at the meeting. The committee in charge of the latter work believes that the specifications will go a long way toward putting the subject on a rational basis. Already, these specifications have been incorporated in the industrial building specifications recently adopted by the National Fire Protection Association.

During the year the institute has co-operated with committees of other associations and technical societies on specifications and subjects of mutual interest. These include specifications for steel railway bridges, highway bridges, welding and wind stresses, in addition to the fire-protection specifications noted above. It has been suggested that the institute undertake the development of standards for the light steel sections which are now coming into wide use for secondary members.

Various Kinds of Competition

Business problems of the steel fabricating industry received close attention, and the sessions devoted to such subjects were marked by active and worth-while discussions. Mill competition, unfair competition within the industry, the competition of other materials such as reinforced concrete, and the new forms of competition, such as that of luxuries against necessities and of industries for capital, received special attention. Outside of the general discussion of these subjects, O. H. Cheney, vice-president, American Exchange Irving Trust Co., New York, and Truman S. Morgan, president, F. W. Dodge Corporation, New York, in formal papers at the annual banquet, added some straight-from-the-shoulder comment of great value to the members. Mr. Cheney laid particular stress upon the fact that the problems of the steel fabricators are little different from those of many other industries in the country, and that it is time they stopped talking about their difficulties as being peculiar to the industry and went to work learning something of the new competition which is affecting most industries.

Technical Subjects — Technical sessions began on Wednesday with a talk by Rudolph P. Miller, consulting engineer, New York, on fireproofing structural steel. By the use of many charts and pictures, Mr. Miller was able to visualize for the membership of the institute much of the work which lies behind the conclusions written into its new fireproofing specifications prepared by the committee of which Mr. Miller is a member. Mr. Miller believes that the time is not far distant when such specifications will be written into general building specifications just as steel and concrete specifications are now included.

Tensile Working Stress in Rivets

Tension in Rivets—Much interest was aroused by the paper of Prof. C. R. Young (University of Toronto) on tensile working stresses in rivets. Attention had been focused on the subject earlier in the session by a statement in the report of Lee H. Miller, chief engineer of the institute, in which he stated that "the economic value of a proper determination of such tensile working stresses is very important. It may be noted that tests on the tensile value of rivets which have been made indicate that the rivet will carry its full normal working stress in tension the same as if no initial stress existed."

Prof. Young first drew attention to the complete absence of guidance on the subject of tension in rivets in all modern specifications, except those of the Canadian Engineering Standards Association for buildings, in which rivets in tension are allowed a working stress of 10,000 lb. per sq.in. He stated that in former years structural steel specifications prohibited any such allowance, but that in recent years they simply have been silent on the subject. This led him to a review of studies which had been made on the subject in the past and eventually to undertake additional tests employing methods of testing rivets in tension which eliminate many of the uncertainties of the earlier tests.

His studies are separated into three series, dealing with rivets (1) in pure tension, (2) subjected to a combination of tension and flexure, and (3) subjected to a combination of tension, flexure and shear. They are being carried on at the University of Toronto with specimens fabricated under normal conditions in the Toronto plant of the Dominion Bridge Co. While the tests are not yet completed, he said that the results obtained in the first series clearly indicate the falsity of the generally accepted theory that no tension should be placed upon rivets because an initial tensile stress, frequently in excess of the yield-point of the rivet material, is developed as a result of shrinkage during cooling. The initial tension in

a rivet shaft may fairly be considered as generated by the resistance to reduction of thickness offered by the plates or other parts connected together by the rivet. The tension which these virtual springs will produce in a rivet shaft will be directly proportional to the amount of contraction produced in them by the pressure of the riveting machine and by the shrinkage of the rivet in cooling. On the other hand, a release in tension on the rivet shaft will be brought about in direct proportion to any reduction in aggregate length of the collars.

In most of the tests reported by Prof. Young, the rivet shaft developed an ultimate tensile strength in excess of the known ultimate tensile strength of the material in standard tension tests. Had the rivets been on the verge of failure due to high initial tension, it would not have been possible to apply the large loads actually applied before failure was produced. Further conclusions as a result of the tests are that the allowable working stresses on rivets in tension will depend both on the diameter of the rivet and upon the eccentricity with which the tensile force is applied. Upon this basis a formula has been devised such that a factor of safety of approximately 4 is maintained with respect to the minimum values obtained in the University of Toronto tests. At the same time, the results obtained in other tests have been considered. For cases of pure tension, and for cases of a combination of tension and flexure, with angles of a thickness comparable to those used in the Toronto tests, the following formula for permissible tensile stress was prepared:

$$P_t = 21{,}000 - 8{,}000\,d - 5{,}500\sqrt{c}$$

in which P_t = permissible tensile stress on rivets; d = diameter of rivet in inches before driving; and c = eccentricity of loading on rivets in inches.

Safe Construction—A plea for greater safety in construction was made by Robert D. Kohn, architect, New York. He pointed out how impossible it is, even with the best city building inspection system, to prevent poor workmanship from getting into buildings put up by incompetent builders or those lacking in a desire to produce the best results, especially speculative building contractors who sublet everything to the lowest bidder without regard to qualifications. As a means of counteracting this condition, he recommends legislation similar to that sponsored by the Joint Committee on Structural Safety in New York, recommendations which would place the responsibility for the employment of competent persons to design and build structures upon the owner, making him criminally liable in case of a failure in the building.

Concrete as a Competitive Material

Reinforced Concrete—Competitive material in the form of reinforced concrete received no little attention, partly in general discussion and partly in the program itself. In view of the unfavorable comment (outside of the institute) upon Professor Swain's championship of steel as opposed to concrete at last year's meeting, the committee this year asked A. E. Lindau, president, American System of Reinforcing, Chicago, to present a paper which would be a defense of reinforced concrete as a structural material. By frankly admitting that he realized that he was in the enemy's camp, Mr. Lindau won the sympathetic interest of his hearers and so was able to refute some of the arguments against reinforced concrete presented in Professor Swain's paper without antagonizing his audience. Mr. Lindau stated that reinforced concrete is not always the most suitable material for any job, but that he thought most people would agree that it is the most adaptable of all structural materials. While there may be uncertainties as to the ultimate strength of reinforced concrete as compared with steel, yet the factor of safety used in reinforced-concrete design is greater, and so offsets any disadvantage on that score. He also pointed out that there is not sufficient evidence to justify any claim that reinforced concrete is subject to progressive failure. He believes that wherever there is evidence of progressive failure, it will be found that the concrete is overloaded.

Ralph Modjeski, consulting bridge engineer, New York, added further to the subject with a paper on the relative merits of steel and reinforced concrete. He endorsed Professor Swain's views, stating that he agreed with most of the statements made in his paper of last year and had little to add. He decried the tendency to use reinforced concrete for every conceivable purpose, expressing the opinion that the type of reinforced-concrete structure which most appeals to him is one in which "the steel frame is sufficient to carry the load, the concrete in which it is embedded providing only lateral stiffness and fire protection, but with no reliance placed on it to carry main stresses." In summing up his remarks, Mr. Modjeski said "Steel can be thoroughly tested before it goes into the structure. It can therefore be relied upon to carry the loads assigned to it better than reinforced concrete which requires not only tests of cement and aggregates over long periods of time, but also a constant and strict supervision during construction. The stresses in steel can be calculated with much more precision than in reinforced concrete. The time required for steel construction is, in most cases, shorter than for concrete. Steel construction may be carried on during freezing weather with perfect safety. It is absolutely permanent when kept protected from moisture."

Wind Stresses in Tall Buildings

Windbracing—Preliminary studies on the design of the structural frame of the American Insurance Union Building at Columbus as regards windbracing were described by Prof. Clyde T. Morris of Ohio State University. His paper restated, in part, data on the same subject presented by him at the fall meeting of the American Society of Civil Engineers (*Engineering News-Record*, Oct. 20, 1927, p. 640).

On the subject of wind velocities and resulting pressures (not dealt with in the earlier paper), Prof. Morris stated that the wind velocities published by the United States Weather Bureau generally are indicated velocities on the standard, four-cup Robinson anemometer. These indicated velocities are about 20 per cent too high as determined by Fergusson and Covert, of the U. S. Weather Bureau, and published in the monthly Weather Review for April, 1924. A study of these records and of other available records of wind velocities and high wind pressures, including an analysis of the stresses produced in the Meyer-Kiser Building and the Realty Board Building in Miami during the hurricane of last year, led him to the conclusion that with proper proportioning and design of connections, the usual wind pressure of 30 lb. per sq.ft. will give a building with a sufficient factor of safety to withstand the most severe storms. Also, he believes that the unusually high pressures developed in storms are of relatively limited areas, and as a result such high pressures will not be exerted at one time over a large surface exposed to that wind. In design, Prof. Morris believes that the stiffening effect of walls, par-

titions and floors should be neglected in calculating wind stresses, that the entire wind load should be regarded as being carried on the steel frame. He also believes that a limit to lateral deflection of buildings under wind action should be included in building-code specifications.

Returning to the subject of wind stresses in the American Insurance Union Building, Prof. Morris pointed out the exceptional opportunities for studying the effect of wind stresses presented by this building. During construction, gage points were established on a number of the columns in the basement for the purpose of checking the dead-load deformations as the construction progressed, and when the steel had reached the twentieth story, which is the first story above the roof of the wing, additional gage points were set on the columns. These points have been preserved by providing movable panels in the fireproofing so that they are available at any time for measurement of stresses due to wind or other causes. There also have been provided targets located at the top and bottom of the longest elevator shaft (34 stories) by means of which the sway of the top of the tower may be observed through a theodolite set up in the bottom of the shaft. Prof. Morris hopes that provision may be made for simultaneous measurements of wind velocity, wind pressures and wind stresses in this building.

High Building Problems

High Buildings—Two aspects of high buildings were considered during the meeting: First, their effect on street traffic conditions, in a paper by George Henry Payne, commissioner of taxes and assessments of New York City, in which he demonstrated the absurdity of claims that tall buildings are the cause of congestion in our city streets; and, second, the economic height of tall buildings, in a paper by W. C. Clark, economist, S. W. Straus & Co., New York. Mr. Clark's figures are the result of a very thorough study of the possibility of a building site in the Grand Central zone in New York occupying a whole 200-ft. block front and having a depth of 400 ft. on the side streets, a site having a land value of $16,200,000. Buildings of heights from 8 to 75 stories designed to occupy this site were studied, and while Mr. Clark said that the analysis of the estimates of all the details of cost going into these buildings has not been completed, it is evident from the work already done that the point of diminishing return lies somewhere near the 75th story. Architects, civil and mechanical engineers, elevator manufacturers, city tax officers and real estate men all took part in the study, and actual estimates of costs of buildings of various heights designed for the site in question were prepared and checked against estimates of the return from rentable space prepared by real estate men. Mr. Clark said that while the site was large and somewhat ideal, it was necessary to adopt it as a basis for such a study in order to be sure that the ground area did not become a limiting factor. Building costs ranged from $5,300,000 for the 8-story building through $13,500,000 for a 37-story building to $21,800,000 for a 75-story structure. Increase in net return remained about constant above the twenty-second story, where it was 6.1 per cent, to 7.6 per cent at the 37th story, and then continued but with a decreasing increment to 9.1 per cent at the 75th story, where the study stopped. A curve of the increment indicates that a decrease would begin at or just beyond the 75th floor height. The design of the steel framing was as near ideal as possible for the site, a fact which kept down the steel cost. It is interesting to note that the cost of the steel frame for various heights of building corresponded closely to the cost of elevators for the same heights of building.

Association's Affairs—Membership in the association has not changed throughout the year, but as its members include representatives of nearly 100 per cent of the industries interested in the fabrication of structural steel, plants which produce more than 90 per cent of the steel produced outside of plants controlled by the steel mills, little increase is to be expected. About 235 members and guests registered for the convention.

The association's income based upon an assessment of 15c. per ton of steel fabricated shows a considerable increase for the past year; but as the institute has increased its activities, largely through the employment of two full-time field engineers, the general sense of the meeting seemed to be that more money could be well spent in the association's activities. The meeting went on record as approving an increase in the assessment up to 25c. whenever the directors think such a change necessary.

The president, W. M. Wood, was re-elected as were the vice-presidents, C. Edwin Michael, C. M. Denise, the treasurer, George E. J. Pistor, and the executive director, Charles F. Abbott. John J. Duffin, of the Duffin Iron Co. of Chicago, was elected a director to succeed Paul Willis.

Crossing Accidents Victims' Fault, U. S. Supreme Court Rules

IN a short but sweeping decision rendered Oct. 31, the U. S. Supreme Court laid down a "standard of conduct" for persons driving upon railroad tracks at grade crossings which puts responsibility for accidents upon them unless they have taken every precaution, including getting out of their vehicles to look up and down the track in case their view is obstructed.

Dora Goodman, administratrix of the estate of Nathan Goodman, sued the Baltimore & Ohio Railroad Co. for the death of Goodman at a grade crossing near Baltimore. She recovered damages in the lower court and this was affirmed by the circuit court of appeals. In a decision read by Justice Holmes, the U. S. Supreme Court reversed this finding and found for the railroad, which in the trial court had interposed the defense that Goodman's death was due to his own negligence.

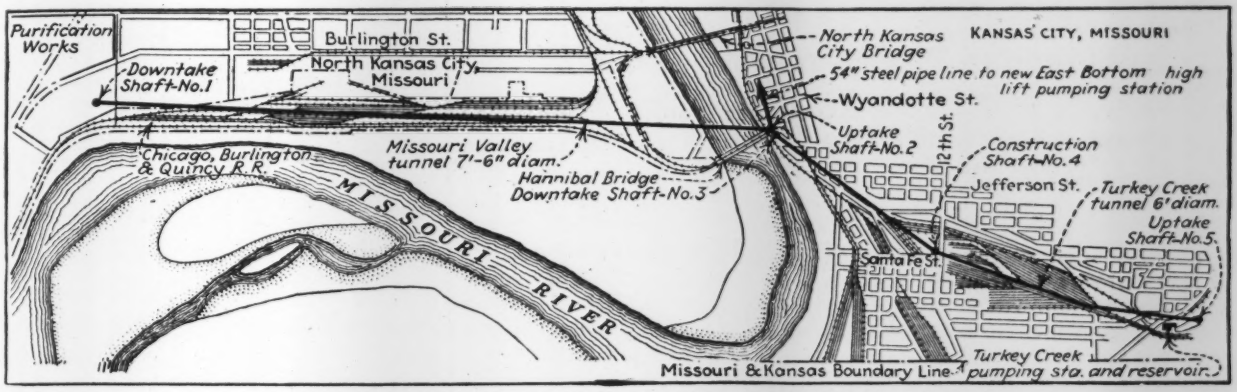
The trial testimony showed that Goodman was driving a truck. He was familiar with the crossing and slowed down to a speed of six to eight miles an hour when he approached it. The testimony showed that view of the track was cut off by a section house 243 ft. from the crossing and that Goodman was within 20 ft. of the crossing before he could have seen the train which caused his death. In reversing the lower courts, the opinion of Justice Holmes says in part:

> When a man goes upon a railroad track he knows that he goes to a place where he will be killed if a train comes upon him before he is clear of the track. He knows that he must stop for the train, not the train stop for him. In such circumstances it seems to us that if a driver cannot be sure otherwise whether a train is dangerously near he must stop and get out of his vehicle although obviously he will not often be required to do more than to stop and look. It seems to us that if he relies upon not hearing the train or any signal and takes no further precautions he does so at his own risk.

New Water Supply for Kansas City to Be Completed in 1928

Works Include Intake, Tunnels, Steel Pipe Line, Pumps and Reservoirs—Water Treatment System

GOOD progress has been made with the new water supply and purification plant at Kansas City, Mo., and it is expected that the entire system will be in service by the summer of 1928. Water from the Missouri River is pumped to the purification plant, in North Kansas City, by four electrically operated centrifugal pumps having a capacity of 35 m.g.d. After filtration it is pumped to the city by four similar pumps. From the purification works a concrete lined tunnel 7½ ft. in. diameter and 15,570 ft. long—known as the Missouri Valley tunnel—extends to and under the river, and then connects with the 6-ft. Turkey Creek Tunnel extending 11,000 ft. to the existing Turkey Creek reservoir and high-lift pumping station. From the end of the larger tunnel a 54-in. steel pipe line 14,000 ft. long extends to the new East Bottom reservoir and high-lift pumping station. The capacity of the new works is 100 m.g.d., with a possible overload of 25 per cent. A general description was given in *Engineering News-Record* of April 8, 1926, p. 573.



MAP OF MAIN FEATURES OF NEW WATER SUPPLY, KANSAS CITY

As to the present situation, the river intake was finished May 11, 1927. The basins, conduits, filters and pumping stations are practically completed. Already in service are the Turkey Creek tunnel, completed in April, 1926; the steel pipe line, Sept. 24, 1926, and the East Bottom reservoir and pumping station, Nov. 12, 1926. It is expected to complete the Missouri Valley tunnel by next April. But by means of a bypass connection around the shaft of this latter tunnel, water from the present high-pressure pumping station at Fairmont and 25th Sts. now flows through the Turkey Creek tunnel and the pipe line to the new East Bottom pumping station, which station will be supplied eventually from the Missouri Valley tunnel. This connection has been in service since May, 1927.

Water Treatment Works—At the new purification plant, water taken from the Missouri River is passed through three traveling screens of ⅜-in. mesh to four preliminary settling tanks having a combined capacity of 16 m.g., equipped with Dorr clarifiers. It is then mixed with lime and alum in two tanks of 2 m.g. combined capacity, where the water and chemicals enter at the top tangentially and leave at the bottom at the center. After coagulation in five basins of 51 m.g. combined capacity it is filtered through 24 rapid sand filters; and finally chlorine is added to the water.

Missouri Valley Water Tunnel—Holing through of the headings of the large tunnel was accomplished at 2:30 p.m. Oct. 28, with but a small error in alignment between the two bores. A heading was driven from each end. On this 7½-ft. tunnel it has been found necessary to timber the roof for almost its entire length, as the shale formation disintegrates very rapidly after exposure to the air, so that falls occur if it is left unsupported for more than 16 hours. Three-segment arch timbering is used, with 2x12-in. lagging and 6x6-in. arch blocks and legs, all of yellow pine. The legs supporting the arch blocks are seated in hitches cut into the sides of the tunnel, slightly above the springing line of the arch. It has been necessary to use considerable dry packing above the timbering.

Gas has been a serious difficulty and caused an explosion in which eight men were killed, as noted in *Engineering News-Record*, Sept. 30, 1926, p. 553. The contractors continue to encounter considerable quantities of gas and have had gas throughout the tunnel. In consequence they have discontinued the use of electrical equipment in the tunnel, all machinery being operated with compressed air and the lighting being obtained by each man wearing a cap light with a closed type of electric battery or a permissible light approved by the U. S. Bureau of Mines. A difficult problem has been to find a permissible dynamite giving such fast flame that it would not ignite the gas encountered at the face. For some time there was difficulty, when firing rounds, to avoid igniting gas or gas feeders at the face, when using ordinary 40 per cent gelatin dynamite. Experiments with different kinds of permissible dynamites resulted in the adoption of Gelobel, which is about the strength of 40 per cent gelatin dynamite but has a very fast flame. Since then there has not been a fire ignited from the blast.

In tunneling, the practice is to drive the heading in stretches of 1,000 to 1,500 ft. and then stop to place the concrete lining, approximately as described in the previous article mentioned. The length to which the heading was driven without concreting depended upon the rapidity with which the shale along the sides of the tunnel began to disintegrate or fall, it being necessary to concrete soon enough so that the timbering would still have good support in the hitches orginally cut. After holing through, there will be approximately 2,000 ft. to

be concreted. It is expected to complete the lining, grouting, cleaning out and testing by April 1, 1928, so that the tunnel can be put into service some time before May.

Engineers and Contractors—The entire system was planned by and is being built under the direction of Fuller & Maitland, consulting engineers, Kansas City, Mo., with A. R. Holbrook, chief engineer, and K. K. King, resident engineer on the tunnels. The contractors for both tunnels are Smith Brothers, Inc., Dallas, Tex., with Charles S. Foreman as general superintendent. Other principal contractors are: River intake, List & Weatherly, Kansas City, Mo.; basins and conduits, James Black Masonry & Contracting Co., St. Louis, Mo.; filters and pumping stations at treatment plant, Chanute Construction Co., Kansas City, Mo.; steel pipe line, Biggs Construction Co., Akron, Ohio; East Bottom reservoir and pumping station, Carrothers Construction Co., Kansas City, Mo.

Modification of Bell's Bund System Simplifies River Control

Expensive Protective Works Avoided at Many Places by Constructing Simple Dikes to Form Still-Water Pockets

By P. Claxton
P. W. D. Irrigation, Punjab, India

A METHOD of river control known as the Bell's Bund system is widely used in India for the protection of railroad embankments at river crossings. Its essential feature consists in using still-water pockets to keep the swift waters of the main stream from reaching the banks needing protection. The possibilities of the system in other locations, not only in India but also on similar rivers in other countries, have been overlooked generally. Consequently, some observations as to its use under different conditions may be of value.

The essential features of the Bell's Bund system, as applied to a railway bridge, are outlined in Fig. 1. Points *A B C*, and *D E F* are the flood banks of a river within which it is free to meander. A railway line crosses at *B E*, and the normal flood width is contracted from *B E* to *G H*, the lengths *B G* and *E H* merely being the railway embankment, built of earth. To keep the river within this contracted width two earthen bunds, *G I* and *H J* are built, running upstream for a short length. These are the "Bell's Bunds" which establish the still-water pockets, by which the river is held under complete control.

These bunds may lie parallel to the axis of the stream, or may be slightly divergent, having *I J* wider than *G H*. Divergence is probably an advantage, but of that we need not take account here. The noses and faces of the bunds exposed to active flow on the river side are paved heavily with stone, a wide apron of which also extends out along the bed of the river. The stone of this apron, as it becomes under-scoured, drops lower and lower, till the face is effectually paved to the point of lowest scour. Thus the noses and river faces of the bunds are impregnable, for more stone can be brought to the site by rail and dumped down should any danger arise. Beyond this no other stone protection is needed. The situation is completely controlled by the still-water pockets, *A B G I* and *D E H J*, since earthwork under these conditions is perfectly safe.

The efficiency of these pockets therefore depends entirely on the stoppage of all flow. To do this, the pockets must be sufficiently deep to neutralize the effect of a swirling attack, which may take place when the river is deflected above the bridge against either bank. Such an attack is indicated in Fig. 1, along *a, b, c*, by the arrow heads, on the left side of the river. The swirl created within the pocket must not reach within dangerous limits to the railway embankment *H E*, which, being unprotected, could not stand up against side erosion. This might happen if the bunds were too short. They are, however, not long, being seldom more than ½ mile

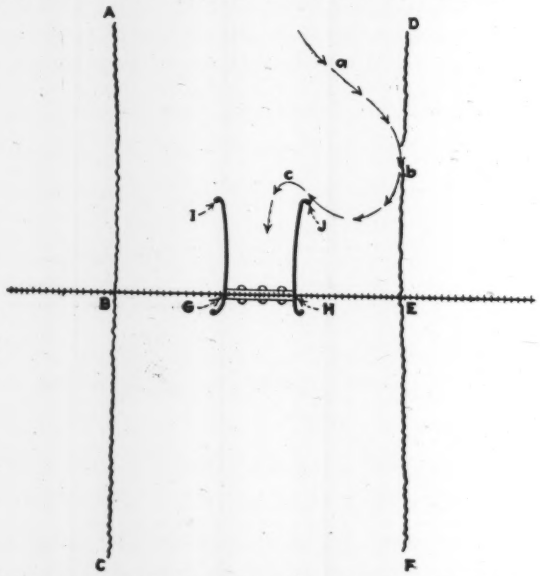


FIG. 1—BELL'S BUND SYSTEM APPLIED TO RAILROAD CROSSING

long for the larger Indian rivers, and they may be much shorter. The erosion of the river bank itself, as it will be noticed, is shown to have occurred at *b*, but is of no consequence, since control is thereby not impaired. During floods river spill may overtop the banks, but this also will be harmless, so long as the railway embankment in the vicinity is itself high enough to hold it.

The still-water pocket is not only the secret of safety, but it has the power of correcting deflected flow, such as shown above *a, b, c*. By tying this up, the loop becomes more and more doubled back upon itself. In this process, while it lengthens, the chord *a c* remains the same, or may grow shorter. Floods overtop the higher intervening shoal along *a c*, and having greater velocity because of shortening, set up retrogression of levels which in time completes a short-circuit *c a*. The still-water pocket, moreover, creates afflux which reacts on the river for some distance upstream. This reaction raises the head at *a*, and in doing so assists the short-circuiting action by increasing velocity along *a c*.

These are the principles which govern the Bell's Bund system of river control. By it is secured not only efficiency but economy. River training for miles upstream of the bridge is eliminated, and one control point at the bridge itself is substituted. Not only so, but

stone protection is confined to the nose and river faces of the bunds, all the rest being built of earth.

Although the still-water-pocket principle is included within the Bell's Bund system, its extension to river control in other directions is generally unknown, or overlooked. As it is a principle it may be dissociated from the Bell's Bund System, and still be the factor of control. The problem is how to form the still-water pocket independently. To show how this may be done the writer will select a few examples which have come under his notice, and which illustrate conditions very dissimilar. In two, the still-water pocket has been applied, while in one it has been neglected. The lesson to be drawn from the neglect is almost more forcible than the lessons gained by the application of the principle.

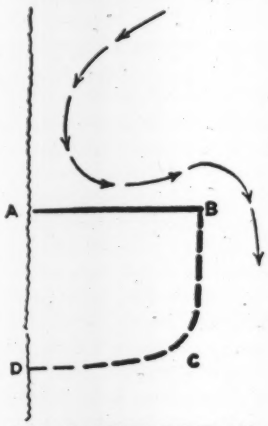


FIG. 2—SPUR DIKE ON THE CHENAB RIVER

In the first example, illustrated by Fig. 2, there is a spur which once formed part of the training works on the river Chenab at the headworks of a canal. The trunk of the spur was built only of earth, but the head *B* was heavily protected with stone. The main stream began an attack against the right bank, and lay as indicated by the arrow heads, threatening to erode the trunk and sever the head. The spur was important, and the head *B* was particularly valuable as it was so heavily protected. After consultation, it was decided to save the spur by building a rear embankment along the alignment *B, C, D,* which at that time was shoaled up and dry. The length *B, C* ran parallel to the axis of the stream, and then, curving round, joined the high bank at *D*. When, therefore, the trunk *A B* breached soon after, the water entered harmlessly into the pocket formed by *A D C B*. In other words, the situation was brought under complete control by the creation of a still-water pocket. Not only so, but the lines of protection were greatly improved, making the spur far more resistive to river attack. If the face of *B C* on the river side had been paved and an apron added, the result would have in effect been one wing of a Bell's Bund system. Such a single wing might be used were it desired to protect a point on one side of the river only, such as a city threatened by river attack.

The second example is given by Fig. 3. Here *A B C* was the main stream of the Indus River, which, by heavily eroding the outer curve *A, B,* was depositing its overcharge of detritus in a shoal below *B*. This shoal in turn was deflecting a stronger flow into the side creek, *a b c,* which was beginning to erode heavily along *b c*. This erosion was undesirable, since a protective flood embankment existed not far behind and was in danger. To effectually stop erosion along *b c,* and to bring the creek under complete control it was decided to construct the spur *M N* of earth, thus creating a still-water pocket *b c M N*. To do so the flow at the head *a* had to be temporarily closed when the river was down, after which the spur dike was completed. It will be understood that during floods the whole of the river bed right up to the high bank was liable to be flooded. At this time, therefore, water would escape round the point *N*, but though heavy, its action was not serious, since water levels in the river had also risen behind the spur dike. This is a point which engineers would do well to remember. To safeguard the spur it was not necessary to protect it with stone. A few side spurs were merely put in, as indicated, to stop longitudinal flow which would have been dangerous because of erosion. It is true that the nose was exposed to erosion, as water escaping round it, at times, had considerable velocity, but as part of the dike was carried away, the shortening had very little effect on its efficiency. It was, in fact, found to be convenient to work with a shorter dike. This shortening might even be done for purposes of regulation, should such be desired, as might happen were a canal on the opposite side fed through the pocket. The full length of the spur dike, on the other hand, could be renewed again, as the river fell.

All this illustrates the capabilities and flexibility of the still-water pocket, unassisted by stone protection, and opens out a field for minor works of variable though efficient control. By it storage reservoirs are possible. These might be made semi-permanent by renewing the spur dike from year to year, and extending it across the scoured reaches beyond the nose, or shortening it, as necessity dictated.

It is true that, in time, deposits of river detritus (or silt) would tend to fill up the pocket, but conditions elsewhere would most probably enable new pockets to be created. While these works may be extended for storage works, they are employed already for inundation canals heads in India, and have passed the experimental stage.

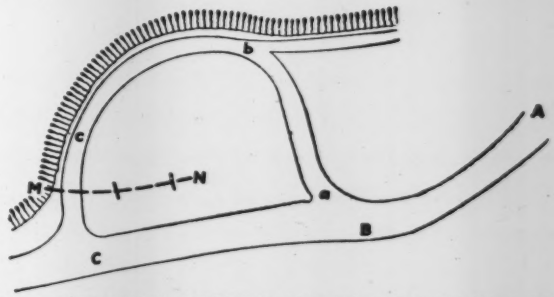


FIG. 3—EROSION CHECKED BY STILL WATER POCKET

The third example in which the still-water pocket might have been employed, but was not, is shown in Fig. 4. Here a torrent, discharging into the Sutlej River, had to be taken under the Sirhind Canal by means of a culvert. To train it on to the super-passage marginal earthen embankments were built at *A, B, C* and *D* and were protected by spurs paved with stone. It will be noticed that these works take the line of opposition. In other words, the torrent was fought in the reaches at which it was thought it might break away. The fight, as it has proved to be, has been never-ending, and still involves frequent renewals.

First consider the reach *A*. It will be noticed that there are two dunes which might have been utilized to form a still-water pocket by simply throwing an earthen embankment across, as shown. This would have reacted on the stream by a cushion of water which is most effectual in curbing its violence. It would also have effectively closed the danger which lay in this direction,

because of a depression which is shown in continuation of and beyond the dunes. This depression was a continual source of anxiety because it was imagined that if the protective works at *A* were destroyed, the torrent would enter the depression in great force, and would through it reach the canal at high velocity, breaching the banks in a few minutes. Such an impression, in the first place, was quite unfounded. Though the torrent raced past the training works at *A*, it would lose its velocity, as a spill, over the higher ground, had these works failed. The spill would in itself become a factor of restraint, laying down detritus heavily along the margin of escape. It would no doubt acquire velocity on entering the depression, but, having no outfall, velocity would very soon be eliminated. The spill would not bear down as a standing wave but would move comparatively slowly, sending forward a very low wave which

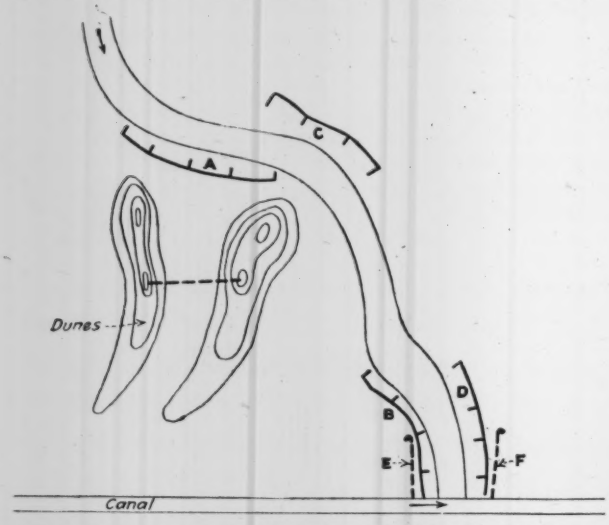


FIG. 4—STILL WATER POCKET COMPARED TO BANK PROTECTION WORK

would first fill the hollows, and then acquire more head and velocity at that point. Anyone may watch this result below the breach of an embankment which has a limited head of pressure behind it, as this spill would have had. On reaching the canal, the spill, instead of gaining velocity, would lose what it had, spreading out against the canal bank, till a still-water lake would be formed. That would be its end.

On the other bank, at *C*, a breach would have been of no consequence, since all the slope is toward the canal, and not away from it.

This leaves the works at *B* and *D*. These also were unnecessary, or might have been much curtailed, had they been built as two straightforward Bell's Bunds *E* and *F*, as shown.

We thus get back to the still-water pocket principle, and by it we can strip the works down to two Bell's Bunds at the crossing. All other works were not only unnecessary, but involved heavy expenditure on renewals. Had the still-water pocket been adopted much trouble could have been avoided.

These few examples establish the utility of the still-water pocket. The writer does not pretend to have evolved any new thing but merely wishes to draw attention to a principle which, though known, is not used as widely as it might be.

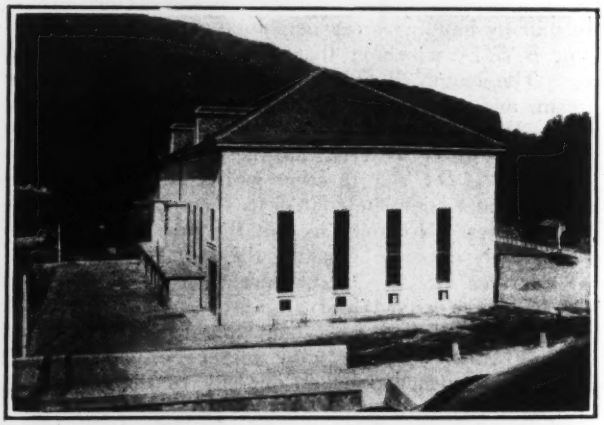
Water Pumped into Reservoirs for European Plants

Runoff Storage for High Head Plants Supplemented by Pumping, Usually Against Lower Head Using Off-Peak Power

By Oren Reed
Assistant Engineer, San Joaquin Light & Power Corp., Fresno, Calif.

HYDRO-ELECTRIC power is developed in the United States by using the natural flow of a river regulated more or less by stored runoff. The rate of flow of some streams, especially in the West, is similar to the power demand. In general, a large amount of storage is not economical because the supplementary power can be generated more cheaply in fuel plants. Under favorable conditions, as at Lake Almanor on the Feather River in California, there is even carry-over or cyclic storage whereby the flow of dry years is supplemented by water carried over from years of greater precipitation.

In central parts of Europe, particularly in northern Italy and Switzerland, conditions are very different, and a proportionally greater value attaches to stored water. In these regions the head developed is usually very high, with a correspondingly small drainage basin. The demand for power has greatly increased there in recent years and on account of the high price of coal the demand is being supplied largely by water power plants. Fed by melting snow and glaciers the streams have their maximum flow in summer and minimum flow in winter.



THE REMPEN POWER HOUSE ON WAEGGITAL PROJECT
This plant contains four 5,100-hp. motors for driving pumps operated, during waste-power periods, to return water to the reservoir.

The winter flow of the Rhine at Eglisau power house, for example, is only one-sixth of the summer flow and a similar condition exists on all Swiss rivers. The present power demand, on the other hand, is greatest in winter due to the lighting and heating load. This discrepancy between power demand and runoff is well illustrated in the accompanying diagram.

In the development of storage reservoirs, therefore, particular attention has been given to the possibility of supplementing the streamflow. Often plants of this sort are operated only during the winter months. In several cases, where storage is most valuable or where the release from storage is to be used through a high-head

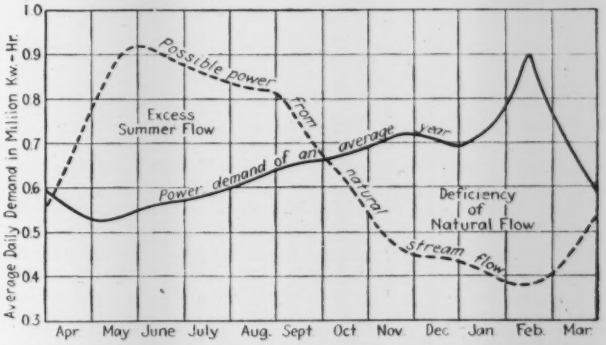
plant or series of plants, water is pumped from intermediate catchment basins into the primary reservoir.

Waeggital—The Waeggital development was completed in 1924 by the city of Zürich and the Swiss North Eastern Power Co. It consists of a storage reservoir, a compensating reservoir and two power houses, Rempen and Sieben, having static heads of 853 ft. and 647 ft., respectively (see *Engineering News-Record,* Sept. 9, 1926, p. 410). This is purely a storage development and is operated only five months of the year, from November to March, inclusive. The storage reservoir, formed by Schrah dam, has a useful capacity of 105,000 acre-ft. and a drainage basin of 15.6 sq. miles. The runoff from this area in a normal year is 74,000 acre-ft. and the remainder is supplied by a pumping plant in Rempen power house. The runoff from the area between Rempen and Schrah dam is collected in the Rempen reservoir and pumped through the penstock and tunnel into the Innertal reservoir. There are four pumping units, each consisting of a centrifugal pump delivering 44.2 sec.-ft. against a head of 853 ft., and direct-connected through a vertical shaft to a 5,100-hp. motor. The power for this pumping plant, furnished by the stream-flow plants of the same system, would otherwise be wasted during the summer. Water released from storage is used in both plants, the total head being 1,500 ft. The Waeggital project, with an installed capacity of 140,000 hp., cost about $14,500,000. In 1925-26 the two plants produced 68.8611 million kw.-hr.; in 1924-25, 74.4509 million kw.-hr. If the yearly charges are assumed to be 10 per cent of the cost of development, this block of power cost about 2 cents per kw.-hr.

Lake Fully—The Lake Fully development is in the Swiss Alps in the valley of the Rhone River. Four units, operating under a static head of 5,400 ft., develop 12,000 hp. Lake Fully, whose water surface is at El. 7,000 ft., is tapped by a short tunnel and pipe line. The neutral storage capacity of the dam was increased by the construction of a masonry dam to give a useful storage of 2,600 acre-ft. The power plant is operated intermittently, being a reserve for a low-head plant. The drainage area tributary to Lake Fully is small and, during periods when the plant is not operating, water is pumped from a small lake, Sorniot, into Lake Fully. This small lake is 450 ft. below Lake Fully. The penstock passes near this lower lake, from which water is pumped through the penstock into the upper lake by a centrifugal pump operated by a 640-hp. motor.

Illsee-Turtmann—In the Rhone Valley near the Lake Fully plant is another interesting development, the Illsee-Turtmann project. This consists of the Turtmann plant, operated by stream flow, and Illsee, a storage development. These two plants operate under static heads of 2,410 ft. and 3,230 ft., respectively. The capacity of Ill Lake has been increased by constructing a 43-ft. masonry dam, behind which the water can be raised to El. 7,680. The lake is tapped by a tunnel, by which a 164-ft. draw-down can be obtained. A 31.5-in. flow line laid in a tunnel carries the outflow to the penstock. About 5,440 ft. below the intake the flow line crosses a small brook. Water from a pond at the head of this brook can be diverted into the flow line because the water level of the pond is 10 ft. higher than Ill Lake. The drainage area of the pond is small and its yield is augmented by a pumping plant at a lower elevation on the same stream. This plant consists of three two-stage centrifugal pumps, each having a capacity of 8.5 sec.-ft. against a head of 361 ft. and being direct-connected to a 500-hp. alternating current motor. The speed of these motors can be varied from 1,470 to 950 r.p.m. to suit the quantity of water and variation in head. In summer, when the Illsee plant is not in operation, water from the pond flows through the pipe line into Ill Lake. The total drainage area thus tributary to Ill Lake is 2.28 sq.mi. and has an annual runoff averaging 4,050 acre-ft. After passing through the Illsee plant the stored water is used in the lower plant, which operates on stream flow for a large part of the year.

Lunersee—Conditions at the Lunersee project in Switzerland, now under construction, are similar to the above examples. The useful capacity of Luner Lake, which is at El. 6,360, was increased to 32,400 acre.-ft. by tapping the lake by a short tunnel. It is planned to pump the flow from a large glacier into Luner Lake by building a pumping plant in the adjoining valley, which will operate under a head of 1,600 ft. The static head of the Lunersee plant is 4,500 ft.



RELATION OF STREAM FLOW AND POWER DEMAND THAT FAVORS PUMPING

Maen—In the Maen plant, now under construction by the Breda Co. in the Italian Alps near the Swiss border the water is drawn from a storage reservoir whose surface is at El. 6,900. A flow line of steel pipe, about 3,930 ft. in length, leads to the penstock. The impulse turbines in the power house will operate under a static head of 2,730 ft. At a point 820 ft. lower in elevation than the storage reservoir a second dam has been constructed and from this diversion pond a flow line about 560 ft. in length is laid to a second penstock which parallels the first pressure line. The Maen plant is a feeder of a large system and does not operate continuously. This makes it possible to increase the water available from the storage reservoir, which has a small drainage area, by the addition of water pumped at night or during the summer from the lower diversion pond through a cross-connection directly into the main penstock. If the pumping efficiency averages 50 per cent the pumped water will produce in the high-head plant 1.6 times the energy which is required to pump it to the upper reservoir. In addition, better regulation is effected for Corvalou plant, a stream flow plant belonging to the Breda system, whose intake is immediately below Maen power house. Corvalou has a static head of 1,825 ft.

Summing up the conclusions formed in observing these conditions, it may be said that the pumping of water into a storage reservoir used for power development is only feasible when the outflow is used in a high-head plant or series of plants. Power for such pumping must be cheap and usually is furnished by stream-flow plants.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Insurance Brokers Must Take Examinations

Sir—Under a Philadelphia date line of Oct. 9, 1927, the *Journal of Commerce* carries a statement from James V. Yarnall to the effect that insurance men throughout Pennsylvania are incensed over the ruling that all agents whether new and inexperienced or old and experienced must stand examination whenever opening a new office or a branch of an old office in a new locality.

Why any legitimate agent should be incensed is puzzling. If an agent is up to snuff in his profession, the examination should be so simple that it would not be worth worrying about. If he is not up on his work, then he should not operate as a broker until he is.

The only justification for an agent or broker's existence is to bring the underwriters and the public together on a sound basis of understanding. Merely to sell insurance and place bonds for commission should not be the beginning and end of an insurance broker's work. He should render a more vital service to both the underwriters and the public. He must know his client's business as intimately as a lawyer and must be able to judge of the client's ability to buy insurance, and the kind of insurance that is best for him. He must also be able to advise the underwriter as to the risk he is taking in issuing insurance to a client. No agent or broker can do this if he is not up-to-date in his work.

As a broker who has handled all kinds of insurance and has specialized in bonding and insurance for contractors, I cannot see, for the life of me, why any agent who is up to his work and has not grown stale should object to Commissioner Taggart's ruling. This ruling strikes me personally as being one of the finest things that could possibly have happened for the protection of the public as well as the legitimate insurance agent.

Our profession has suffered too much in the past by pirates of the fly-by-night nature who have little interest beyond getting their commissions. There are a few of us who for years have been striving diligently to give the insurance profession the dignity and public esteem that it should have.

In the line in which I specialize, that on contract bonds, I continually find worthy contractors who have suffered in their work by inadvertently placing the bonding of their contracts in the hands of agents who are not properly informed or properly equipped to handle the work.

It is just as essential for an insurance broker to be up-to-date and thoroughly familiar with every phase of the line of insurance he handles and all its requisites as it is for a doctor to keep up-to-date on his specialty or a lawyer on his. This ruling should be received with rejoicing by every agent in the country who has the interest of the public and his own profession at heart, and these real agents should not fear an examination at any time. For my part, I think it would be a good thing if all agents were required to pass an examination periodically.

New Nork, N. Y.,
Oct. 19, 1927.

HARMON V. SWART,
Insurance Broker.

[The ruling referred to by our correspondent is dated Sept. 1, 1927, and was issued under the hand of the Insurance Commissioner of Pennsylvania. The document comprises an application questionnaire of rather searching character; announces the requirement of an examination; schedules, dates and place of examination, and states kind of applicants desired. Briefly the ruling calls for "an applicant twenty-one years of age, reasonably familiar with the provisions of the insurance laws of this commonwealth and with the character of the contract he anticipates selling, of good business reputation and not a cashier, officer or employee of a state or federal bank, and in the case of a corporation such applicant must be authorized by the provisions of its charter to engage in the business of insurance." It states further that "An applicant for a license to sell insurance must appreciate the ethics of his intended profession and will be expected to measure up to a full standard of integrity, honesty and fair dealing, not alone to the company he represents but to the public he deals with, and any breach of this trust or standard will be deemed cause for the revocation of his license. The day has passed when the company hands the agent a rate book and turns him loose to make trouble for himself, the company, the public and this department. No other life work of so serious and far-reaching importance is thus undertaken and insurance can no longer pay the price of such type of agents and the cost of the turn-over resulting from ill-prepared agents quitting either in disgust or disgrace. Such agents cost money and the cost is reflected in the insurance rate which must be kept as low and reasonable as possible." This ruling is perhaps the most drastic which has been adopted by any state insurance regulating body.—EDITOR.]

Unionization for Engineers

Sir—The action of the Board of Direction and the Secretary of the American Society of Civil Engineers in addressing a letter to the Board of Estimate and Apportionment of New York City and appealing for the increase of engineers' salaries is certainly commendable. The tone of the letter and the use of the phrase "Powers that Be" mark a new departure for communications issuing from the headquarters of the Am. Soc. C. E.

It appears to me, however, that all such appeals as well as committee activities in the preparation of charts showing average salaries that engineers may expect after varying numbers of years of experience are only too likely to be fruitless and abortive. I sincerely hope that in this case the plight of the humble brain workers in the New York City Civil Service will be relieved. What a commentary on our valuation of service when the productive work of the engineer whose accuracy and clear thinking are so essential to the successful construction of facilities of lasting benefit to the community for generations is rewarded by $1,500 to $3,000 salaries, while the salesman expects and receives a minimum of $5,000 annually, with more usual returns of $10,000 to $20,000.

After years of search for a remedy for this injustice, I have come to the conclusion that the engineer-executive himself is largely responsible for the situation, and that he can never withstand the pressure of the finance departments for low salary budgets until he is actually forced to do so. And the only effective force is unionization on the part of the engineer workers. When it is impossible to get men who will accept low salaries because all have united in an agreement as to definite minimum salaries, the engineer-executive would be able to force higher budgets on his superiors who control the purse strings. In spite of their many faults, labor unions do get results.

It seems as though engineers cannot get away from the spirit of individualism. That hoary half-truth "Competition is the life of trade" is all too potent in our rationalization of the competitive system. And more potent still is the hope that some day even we ourselves may become great high salaried engineer-executives, forgetting how relatively few are the numbers of such positions available. Then, too, our salaries are paid by the "Powers that Be": read Veblen's book "The Engineer and the Price System." We should realize that emulation and co-operation by large numbers of well-paid enthusiastic workers is more effective than the competitive spirit. The Ford idea of big wages for multitudes of workers to increase purchasing power should permeate engineering service. It will probably have to be forced on engineer-executives by the unionization of engineer workers.

New York, N. Y.
Oct. 15, 1927.

J. P. J. WILLIAMS,
Civil Engineering Dept.,
Cooper Union.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Holland Vehicular Tunnel Toll Rates Are Fixed By Two State Commissions

Toll rates which are to be charged for passage through the Holland vehicular tunnels under the Hudson River at New York have been fixed by the tunnel commissions. They are based on the rates now charged on the cross-river ferries in the neighboring region, some being slightly more, others less than those charged on the boats.

The rates are as follows:

Motorcycles	$0.25
Passenger automobiles (with capacity up to seven passengers), ambulance and hearse	.50
Buses (up to and including 29 passengers operating capacity)	1.00
Trucks (up to two tons)	.50
Two-ton to five-ton trucks	.75
Five-ton to ten-ton trucks	1.00
Ten-ton to twelve-ton trucks	2.00

Truck weights are gross weights, irrespective of actual load at the time; *i.e.*, weight of truck plus its rated capacity.

Trailers are charged as separate vehicles, in accordance with above schedule.

Special rates are to be charged for vehicles outside these general classifications. No account is taken of the number of passengers in passenger automobiles unless the number is over seven. Vehicles excluded are:

Bicycles, hand or push carts, wheelbarrows, pedestrians, double-deck buses, horse-drawn vehicles, vehicles having axle loads in excess of twelve tons or wheel loads exceeding 800 pounds per linear inch width of tire, metal tired vehicles and vehicles and motor vehicles that are smoking. No bus will be admitted into tunnel unless all passengers are seated on seats permanently affixed to the bus.

Explosives, inflammable liquids, corrosive liquids (including powerful mineral acids), compressed gases of poisonous nature, poison gases or liquids. Also excluded are loose hay, straw or other material ordinarily combustible and not properly packed.

Speed of vehicles in the tunnels is restricted to 30 miles per hour; vehicles are to keep 75 ft. apart in line and slow moving vehicles are required to keep in one line. No passing will be permitted except upon authority of traffic police. Headlights are to be put out in the tunnels.

A description of the method of operating the tunnels is given on p. 700 of this issue.

Arthur Kill Bridge Paving Contracts Awarded

Final contracts on the two Arthur Kill bridges between Staten Island and New Jersey were awarded by the Port of New York Authority October 26. These contracts, for the concrete decks or paving, went in each case to the lowest bidder. The contract for paving the Outerbridge crossing between Tottenville, S. I., and Perth Amboy, N. J. was awarded to the Cornell Contracting Co., for $1,626,730. There were six bids on this work ranging from that of the Cornell company to a high figure of $1,065,060. The paving contract for the Elizabeth-Howland Hook bridge was awarded to Albert A. Volk, Inc., New York, for $478,650. There were seven bids for this contract with figures ranging from the Volk bid to $887,950.

The Outerbridge crossing contract involves the laying of concrete roadway slabs and curbs for the full length of 8,700 ft. of the steel structure and the concrete paving of the Elizabeth structure will extend the full 7,100 ft.

McGraw-Hill and A. W. Shaw Form Subsidiary Company

The McGraw-Hill Publishing Co., Inc., and the A. W. Shaw Publishing Co. of Chicago have formed a subsidiary publishing company known as the McGraw-Shaw Co. to publish *Factory, Industrial Management, Industry Illustrated,* and *Industrial Engineering.* No change has been made in the corporate status of the parent companies. Under the announced publishing plan *Factory* and *Industrial Management* will be combined as *Factory and Industrial Management,* starting with the January issue. *Industry Illustrated* will be consolidated with *Industrial Engineering,* and beginning with the December number will appear under the name *Industrial Engineering* with which is consolidated *Industry Illustrated. Factory and Industrial Management* will serve the top production executives in problems of production management and policy, and *Industrial Engineering* with which is consolidated *Industry Illustrated* will deal with all phases of plant services—mechanical, electrical, or otherwise—through which production is attained.

Township to Carry Zoning Case to U. S. Supreme Court

Appeal to the U. S. Supreme Court from decisions of the New Jersey Court of Errors and Appeals which would compel the township of Maplewood, N. J., to grant a permit for the construction of a 32-story apartment house is proposed by the township authorities. Apparently the basis of the suit is to be the contention of the township that the proposed apartment house would be a common nuisance, which contention was ruled against by both the trial court and the Court of Errors and Appeals. Maplewood is a small suburb of New York City.

Last of Twelve Segments Of Oakland Estuary Tube Sunk Into Place Oct. 29

The last of the twelve segments in the Oakland estuary tube was successfully sunk into place Oct. 29. Using the methods devised for keeping the interior accessible at all times, control during sinking was so accurate that the 200-ft. segment was placed in 90 ft. of water on a 4.6 per cent grade and with a clearance of only 34 in. between segments already in place.

All that remains yet to be done are the pouring of the joints, the concrete ceiling, sidewalks, etc., and placement of the backfill. The portal building superstructures are to be built and provided with ventilating fans and other equipment under separate contract. The 1,000-ft. Oakland approach to the subway, built behind a cofferdam, was completed two months or more ago. The Alameda portal building is completed and the cofferdam is in place for construction of the approach at this end. It is expected that the subway will be ready for use early in 1928.

Details of construction of the tube segments were contained in *Engineering News-Record* Oct. 28, 1926, p. 692.

Gen. J. J. Carty Awarded John Fritz Medal

The John Fritz Gold Medal for 1928 has been awarded to Gen. John J. Carty, of New York, for his achievement in telephone engineering. This award is made annually by a board of sixteen representatives of the American Societies of Civil, Mining and Metallurgical, Mechanical, and Electrical Engineers.

The medal is awarded not more than once a year for notable scientific or industrial achievement, without restriction either as to nationality or sex. It is a memorial to John Fritz, late of Bethlehem, Pa., long a leader in the American iron and steel industry. The award to General Carty is the twenty-fourth, the first having been made to John Fritz in 1902 in celebration of his 80th birthday.

The presentation of the medal will be made in February, 1928, in connection with the annual meeting of the American Institute of Electrical Engineers at the Engineering Societies Building, 29 West 39th St., New York City. The medal will be presented to General Carty by Robert Ridgway, past president of the American Society of Civil Engineers and chairman of the board which made the award. General Carty is a vice-president of the American Telephone and Telegraph Co.

Steel Treaters to Meet Nov. 14

The New York chapter of the American Society for Steel Treating will have as the general subject of its meeting Nov. 14 in the Merchants' Association rooms, "Strong Steel for Modern Long-Span Bridges." The designers' and owners' requirements will be outlined by Leon S. Moisseiff, consulting engineer, New York. Other papers include "Manufacture of Acid Steel for Suspension Cables," H. C. Boynton, metallurgist, John A. Roebling's Sons Co.; "Wire Drawing and Heat Treatment," A. V. De Forest, research engineer, Page Steel & Wire Co.; "Manufacture of Structural Silicon Steel," H. T. Morris, metallurgist, Bethlehem Steel Co.; "Nickel Steel for Long-Span Bridges," Clement E. Chase, of Modjeski & Chase, consulting engineers, Philadelphia; and "Limitations Set by the Fabricator and Erector." Prompt attendance is requested of those intending to attend the sessions, as the program is long and must, the secretary reports, start on time.

Former Editor of Electric Railway Journal Dies

HARRY L. BROWN, former editor of *Electric Railway Journal*, one of the McGraw-Hill publications, died Oct. 23 at Toledo, Ohio, following an operation for appendicitis. He was 38 years of age. At the time of his death he was secretary of the Ohio Brass Co. and lived at Mansfield, Ohio. Mr. Brown graduated from the University of Michigan in 1912, spent two years as assistant editor of *Electric Traction*, served a year with the Chicago Telephone Co., was assistant editor of *Electrical World* for a year, then from 1916 was, successively, assistant editor, western editor, managing editor, and editor of *Electric Railway Journal*.

Water Company Wins Temporary Rate Victory

On the ground that the case should have gone first to the Circuit Court of Appeals, the U. S. Supreme Court on Oct. 10 dismissed the appeal of the Public Utilities Commission of New Jersey from a decision of the Federal District Court granting an injunction to the Middlesex Water Co. against a rate schedule ordered by the commission.

The Middlesex Water Co. supplies water in six municipalities in Middlesex and Union Counties, New Jersey. In 1924, the commission ordered the company to put into effect a new rate schedule based on valuation for rate-making purposes as fixed by the commission. The company filed suit in the Federal Court to restrain the order on the ground the rates were confiscatory inasmuch as they were based upon a valuation which the company contended was too low. The District Court held the rates confiscatory in a decision in January, 1926, and granted an injunction to the company.

Engineering Fifty Years Ago

From *Engineering News*, November 3, 1877

THE westerly caisson of the bridge across the Hudson River at Poughkeepsie, N. Y., which the American Bridge Co., of this city, are constructing, is fixed on the solid gravel bed 97 ft. below the surface of the water. The second caisson is sunk 75 ft. below the surface. The depth of the mud is greater than with the first pier, so that a foundation will be secured 112 ft. below the surface. Both these caissons are immense timber structures, and will be filled with solid concrete to a point 25 ft. below the surface, where the granite pier will begin. All the piers for this bridge will be sunk to a depth greater than that of any bridge piers in the world.

Technical Divisions of Am. Soc. C. E. Nominate Executive Committees

The nine divisions of the American Society of Civil Engineers have nominated the executive committees as listed below. In accordance with the constitution, at least thirty days before the annual meeting of the society a letter ballot will be issued on the election of next year's executive committees, and this ballot will be canvassed Jan. 16, 1928.

CONSTRUCTION DIVISION

Arthur S. Bent, Bent Bros., Inc., Los Angeles; Arthur C. Everham, Western contract manager, Raymond Concrete Pile Co., Kansas City, Mo.

HIGHWAY DIVISION

John H. Ames, city manager, Ames, Iowa; Henry B. Drowne, engineer, Lane Construction Corporation, Longmeadow, Mass.; and C. E. Myers, deputy chief, Bureau of Highways, Philadelphia.

IRRIGATION DIVISION

Charles H. Lee, consulting hydraulic engineer, San Francisco; J. B. Lippincott, consulting hydraulic engineer, Los Angeles; Fred C. Scobey, senior irrigation engineer, U. S. Department of Agriculture, Berkeley, Calif.; and G. E. P. Smith, professor of irrigation engineering, University of Arizona, Tucson, Ariz.

POWER DIVISION

H. K. Barrows, professor of hydraulic engineering, Massachusetts Institute of Technology, Boston; L. F. Harza, consulting hydro-electric and hydraulic engineer, Chicago, Ill.; and H. deB. Parsons, consulting engineer, New York.

SANITARY ENGINEERING DIVISION

Russell Suter, State Department of Public Works, Albany, N. Y.; E. B. Whitman, consulting engineer, Baltimore, Md.; and C. G. Wigley, sanitary engineer, Atlantic City, N. J.

STRUCTURAL DIVISION

A. G. Hayden, designing engineer, Westchester County Park Commission, Bronxville, N. Y.; V. G. Thomassen, assistant engineer, American Bridge Co., New York; and J. J. Yates, bridge engineer, C. R. R. of N. J., Jersey City, N. J.

SURVEYING AND MAPPING DIVISION

C. H. Birdseye, chief topographic engineer, U. S. Geological Survey, Washington; G. M. Bowers, assistant director of public works, Richmond, Va.; William Bowie, chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.; C. T. Johnston, professor of geodesy and surveying, University of Michigan, Ann Arbor, Mich.; and R. S. Patton, hydrographic and geodetic engineer, U. S. Coast and Geodetic Survey, Washington, D. C.

WATERWAYS DIVISION

George F. Nicholson, harbor engineer, Los Angeles; George B. Pillsbury, Lt.-Col., Corps of Engineers, U. S. A., Detroit, Mich.; and Louis C. Sabin, vice-president, Lake Carriers' Association, Cleveland, Ohio.

CITY PLANNING DIVISION

C. E. Grunsky, past-president, Am. Soc. C. E., consulting engineer, San Francisco; John Nolen, city planner, Cambridge, Mass.; and Edward M. Noyes, consulting engineer, Dallas, Texas.

Kill van Kull Bridge Progress

At a meeting of the Port of New York Society on Oct. 26, the engineering staff was authorized by the Port Authority to proceed with application to the War Department for approval of plans for a span over Kill van Kull between Bayonne, N. J. and Port Richmond, Staten Island. The preliminaries to the building of this bridge have reached the point at which all is in readiness for the submission of necessary information to the federal officials. According to reports from the Port Authority, this may mean that bonds will be offered for sale in the late fall. The Kill van Kull bridge will include provisions for rapid-transit facilities.

To Study Tidal Power Site

The proposed scheme to develop power on the Petitcodiac River in the province of New Brunswick by utilizing the great rise and fall of the tides of the Bay of Fundy in that river, is to receive immediate attention. It has been announced by Matthew Lodge, a director of the Canadian National Rys., that a staff of government engineers will visit the scene of the proposed development to make a complete survey of both the Petitcodiac and Mamramcook rivers in order to ascertain the exact power potentialities.

Hydraulic Traveling Fellowship Course Enters Second Stage

The six engineers now studying in the hydraulic laboratories of Germany under the traveling fellowships of American engineering societies have completed their first stage at Danzig, and are now separating to go to technical universities at Karlsruhe, Charlottenburg, etc. for the winter semester. Most of them went over in July and after a brief tour of inspection of the principal laboratories, settled down in Danzig for the double purpose of intensive study of the language and a special course in dimensional analysis kindly repeated by Prof. Winkel during the vacation period for their benefit.

During the holiday, vacation tours of inspection will be made to engineering works. Possibly at the opening of the spring semester there will be changes of location to other laboratories. After the close of the semester the full year of travel will be rounded out by further tours of inspection.

The holders of fellowships for the present year are:

From the American Society of Civil Engineers—M. T. O'Brien, instructor in hydraulics at Purdue University; L. G. Straub, and F. T. Mavis, fellows of the University of Illinois.

From the American Society of Mechanical Engineers—H. N. Eaton, late physicist at the U. S. Bureau of Standards; and B. R. Van Leer, assistant professor of mechanical engineering at the University of California.

From the Boston Society of Civil Engineers—K. C. Reynolds, assistant professor of hydraulic engineering at Massachusetts Institute of Technology.

From the Massachusetts Institute of Technology — John Drisko, post-graduate, traveling fellowship in engineering.

Ordinarily only one appointment per year will be made to this traveling course. For the present year more were made because of the widespread interest in flood control and other hydraulic problems at the moment.

Half Million for New Engineering Buildings at Wisconsin

An appropriation of $577,000 for a new mechanical engineering building at the University of Wisconsin, at Madison, Wis., was made by the state legislature this year. In addition there is an appropriation of $30,000 for moving and setting up the present equipment in the new laboratories. This structure will be one of a new group of engineering buildings to be located on a part of the campus where future extensions can be made more readily than at the present group. As the new structures are completed the old ones will be utilized for other departments of the university. The mechanical engineering building will have a gross volume of 1,750,000 cu.ft. and a net floor space of 95,000 sq.ft., divided as follows: engineering shops, 42,000 sq.ft.; steam and gas engineering, 40,000; machine design, 7,000; engineering college mechanics, 6,000 sq.ft. With the completion of this building the present overcrowded conditions of the mechanical engineering laboratories will be relieved and space will be available also for the laboratories of the mechanics department.

Road Builders Nominate

R. Keith Compton, director of the Department of Public Works, Richmond, Va., has been nominated for president of the American Road Builders' Association. The vice-presidents are as follows: W. A. Van Duzer, assistant chief engineer, Pennsylvania Department of Highways; D. B. Dimick, president, American Casting Co., Birmingham, Ala.; S. F. Beatty, president, Austin-Western Road Machinery Co., Chicago; and Samuel Hill, honorary life president, Washington State Good Roads Association, Seattle. James H. MacDonald has been re-nominated as treasurer. Three-year directors are: H. K. Bishop, Washington, D. C.; W. S. Godwin, Baltimore, Md.; P. L. Griffiths, Pittsburgh, Pa.; W. R. Neel, East Point, Ga.; J. E. Pennybacker, New York; T. J. Wasser, Jersey City, N. J.; and S. M. Williams, Chicago. The ballot for these officers will be canvassed at the annual convention of the American Road Builders' Association in Cleveland next January.

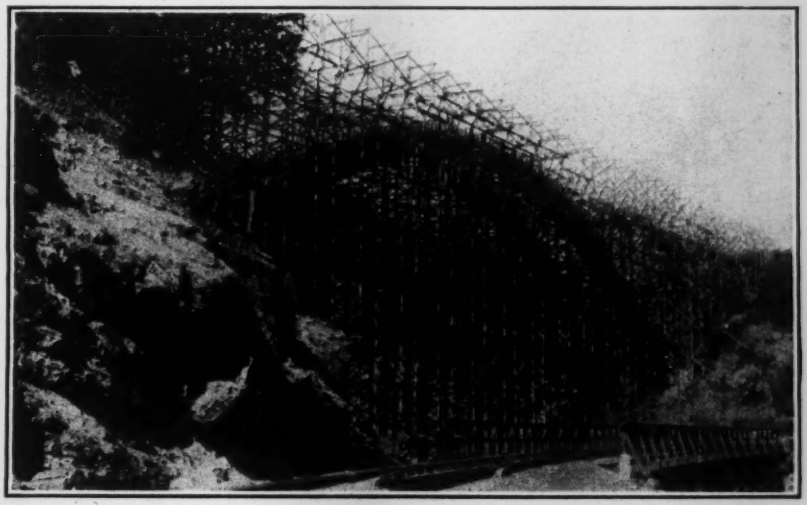
Indianapolis Mayor's Conviction May Halt Bond Sales

Inability of the city controller of Indianapolis to dispose of city bonds for public improvements may halt a number of large projects now under consideration by the city. The situation arises out of the city political muddle which resulted in the recent conviction of Mayor John Duvall of violation of the corrupt practices act of the state.

Three large firms of attorneys in Indianapolis, who advise practically all the large bond houses of the state on the legality of bonds, have given opinions that because of the sentence in criminal court, which was a fine of $1,000 and 30 days and which prohibited the mayor holding office for four years, any bonds signed by him would not be legal and consequently would be poor investments. These houses likely will not be bidders on any bonds the city offers until the mayor either resigns or is forced out of office.

If prolonged, the situation will cause a great hardship on contractors and building material men. Although the mayor has taken no direct steps to have the city legal department verify the legality of bonds, either through an opinion by the corporation counsel or by a lawsuit, it is believed this will be done.

HIGH CONCRETE ARCH OF 235-FT. SPAN UNDER CONSTRUCTION



A BRIDGE is now under construction across Dog Creek on the Pacific Highway about 40 miles north of Redding, Calif., that has a 235-ft. open spandrel arch span and whose roadway is 125 ft. above the stream bed. The structure is to be known as the Harlan D. Miller bridge, in honor of the late bridge engineer of the California Highway Commission.

In addition to the main span the structure includes eight approach spans, the total length being 550 ft. The roadway is 24 ft. wide and the cost of the completed structure will be slightly more than $100,000. Rather unusual problems in the deformation of the timber falsework were met because of the great weight of the arch rib and the height above stream bed at which this weight was temporarily supported.

Contract for the bridge is held by Bordwell & Brugge, Napa, Calif., and the work is under the direction of the bridge department of the California Highway Commission.

Membership Requirements in Am.Soc.C.E. Changed

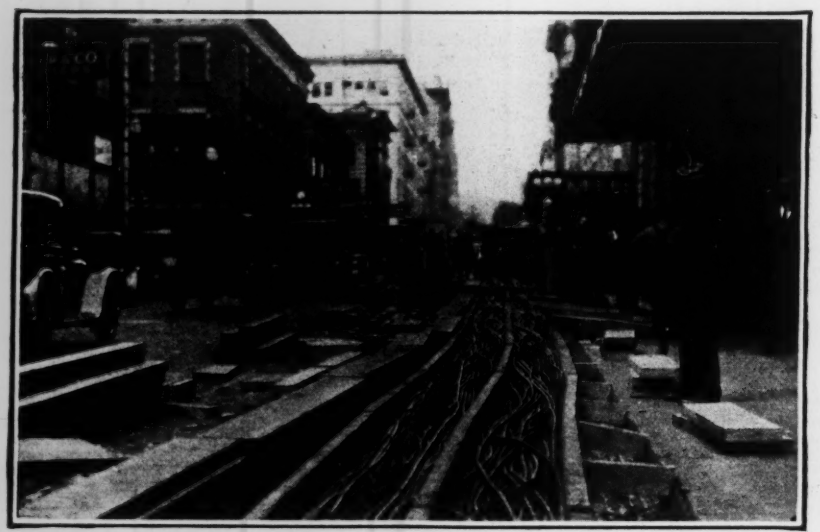
An amendment changing the requirements for membership in the American Society of Civil Engineers was declared passed at the October meeting of the society and becomes effective in 30 days. The new amendment increases the minimum age for the grade of member from 30 to 32 years and the amount of active practice from 10 to 12 years. It also increases the requisite number of years of active practice for the grade of associate member from 6 to 8 years. The minimum age for the grade of associate member has been kept at 25 years, in order that there may not develop a period in which the junior members will become discouraged and drop out of the society. The amount of credit allowed as active practice for graduates from engineering or architectural schools of recognized standing is increased from 2 to 4 years.

The objective sought by the new amendment is neither a lowering nor raising of the standard of membership, but rather a remedying of a situation which has for some time been held improper. A person leaving high school and going to work as a tracer, draftsman or rodman and pursuing this occupation for 4 years can apply all of this time as active practice on his application for membership in the society. If this same person had gone to an engineering school of recognized standing for 4 years and graduated therefrom, he would be permitted to consider his training as only 2 years of active practice in applying for membership. In this way the trained man is penalized 2 years as compared with the man who receives a casual training during his 4 years of work, admittedly of a sub-professional nature. The new amendment places the technically trained man at least on a par with a man not so trained.

Bids Asked for Wachusett-Coldbrook Water Tunnel

Bids for about 14 miles of tunnel with a finished section 12¾ ft. high and 11 ft. wide, generally of horseshoe shape, will be received on Nov. 18 by the Metropolitan District Water Supply Commission, Boston, Mass. The job will also include a 205- and a 245-ft. shaft. Six other shafts from 315 to 660 ft. deep are nearly completed. The tunnel is known as the Wachusett-Coldbrook, will lie in the towns of Boylston, Holden, Rutland, Oakham and Barre, Mass., and will be part of the aqueduct to deliver water from the Ware and Swift rivers to the existing Wachusett reservoir of the Boston Metropolitan water system. Frank E. Winsor is chief engineer of the special construction commission already mentioned.

THREE MILES OF POWER CABLES LAID ON STREETS AS EMERGENCY MEASURE



EMERGENCY repairs were quickly made recently to the Portland Electric & Power Co. service by laying some 15,000 ft. of rubber and waterproofed cables in temporary plank conduits on the street surface next to the curb. The damage was sustained when a heavy rain during an electrical storm attained such an intensity as to tax the stormwater run-off facilities. At the corner of 6th and Alder Sts. the water poured into a manhole where repairs were being made to a defective electrical cable and caused a short circuit. The insulation became ignited and burned out the main power cables supplying 70 per cent of the power for the business part of the city and over half the street car lines. Within a half hour after the shutdown some street cars were running and in two hours all cars were running. Electric power for elevators, presses and general power service began to come in in an hour and in 24 hr. was back to normal.

Washington Notes

AN INCREASE of $10,000,000 in the capitalization of the government-owned Inland Waterways Corporation probably will be recommended to Congress. Users of the barge service on the Mississippi and Warrior rivers recently appeared before the Secretary of War and urged an increase in the capitalization from $5,000,000 to $50,000,000. This was held to be necessary to provide adequate equipment for the handling of the tonnage being offered. At present only part of the freight is accepted.

Apparently there is no support in the administration for a large expansion of the barge service, but it believed a plan can be worked out which will encourage private enterprise to establish contract carriers. Private capital is unwilling, it appears, to assume common carrier responsibilities at this time, but the experiment which the government has been conducting has shown, it is believed, that such bulk commodities as bauxite, sisal and grain could be handled profitably by a private operation which would relieve the government line so it could take care of business moving less regularly and in smaller volume.

THE Arizona Edison Co., of Douglas, Ariz., has applied to the Federal Power Commission for a preliminary permit covering a project on the Gila River in Graham and Greenlee Counties. It is proposed to erect a dam 260 ft. high and 1,700 ft. long. It is estimated that 19,000 hp. can be made available. The application cannot be considered at this time because of the act of March 4, suspending consideration of any applications in the Colorado River Basin.

THE Chief of Engineers has reported to the Federal Power Commission on the application of the Savannah River Power Company for a license covering the Clarke Hill site on the Savannah River. It is proposed to develop 35,000 hp. of primary power, but 120,000 hp. will be installed.

NOW that the President of Mexico has appointed the three commissioners to represent that republic on the International Water Commission, it seems probable that the first meeting will be held just as soon as Congress appropriates the expense money necessary. As the funds probably will be carried in the deficiency bill, it is expected that the money will be available early in the session. The meeting probably will be held in January at El Paso. The Mexican members have established their headquarters at Juarez, Chihuahua. The American members of the commission are: Dr. Elwood Mead, chairman; General Lansing H. Beach and W. E. Anderson. The Mexican members are Gustavo P. Serrano, Federico Ramos and Janvier S. Mejorada.

Personal Notes

F. E. TURNEAURE, dean of the college of mechanics and engineering at the University of Wisconsin, has been granted leave of absence until February, 1928, for a tour of South America. Professor Frank Woy, of the department of engineering administration, has been granted leave of absence until the end of 1928.

J. B. STRAUSS, Chicago, Ill., president of the Strauss Bascule Bridge Co., announces that the corporate name of the company has been changed to the Strauss Engineering Corporation, Mr. Strauss remaining president.

CARL S. HARPER, for several years with Harrington, Howard & Ash, bridge engineers, Kansas City, Mo., and chief draftsman for them since 1924, has joined the engineering department of the Jones-Hettelsater Construction Co., Kansas City, Mo., which is engaged in the design and construction of grain elevators, flour mills and warehouses.

M. L. MCCAULEY, formerly superintendent of construction for the Harper Construction Co., is now at Lansing, Mich., employed by the Michigan State Highway Department on bridge design.

MAX BROWN, formerly a draftsman for Babcock & Wilcox Co. Bayonne, N. J., is now located at Oakmont, Pa., as resident engineer for the William B. Scaife Co. on the construction of a water purification and filtration plant.

CARL F. BRUSH, for the past eight months in charge of the study and design of the proposed sewer system for the city of Venice, Fla., for Black, McKenney & Stewart, consulting engineers of Washington, D. C., has been transferred by them to carry on an economic survey of the City of Columbus, Ga., and the territory contiguous to the Chattahoochee River from Columbus to Apalachicola, Fla. The study is made for the purpose of requesting canalization of the Chattahoochee River for the betterment of the freight situation in this territory. Mr. Brush has been in all parts of the world on engineering work since 1899, when his professional career started.

MAGNUS GUNDERSEN, for the last twelve years with Graham, Anderson, Probst and White, Chicago, has been promoted to the position of chief engineer of that firm. Mr. Gundersen is a young Norwegian engineer who received his technical education at the Technical College at Trondhjem, Norway.

E. W. LANE, until recently hydraulic engineer for the Mississippi River Spillway Board, located at New Orleans, has transferred to the office of the Chief of Engineers, Washington, D. C. for studies on the plan for controlling the Mississippi River floods. Mr. Lane worked on flood prevention studies of the Miami Conservancy District from 1914 to 1920. He then represented the Morgan Engineering Co. on flood prevention and waterway improvement studies on the Yangtze and Huai rivers and Grand Canal in China. In 1924 and 1925 he was assistant engineer, Pueblo flood protection works. Later work included studies for the St. Lawrence Waterway Board on the St. Lawrence Waterway and control of the Great Lake levels.

W. CHASE THOMSON, Montreal, who for some time has been engaged by the federal department of railways and canals, as bridge and structural engineer to the Joint Board of Engineers working on the St. Lawrence deep waterway and power project, has joined the engineering staff of the Dominion Bridge Co., Ltd., Montreal.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Dallas, Texas, Nov. 14-18, 1927.

ASPHALT PAVING CONFERENCE: Under the auspices of the Asphalt Association and Association of Asphalt Paving Technologists; annual conference Atlanta, Ga., Nov. 28-Dec. 2, 1927.

HIGHWAY RESEARCH BOARD, NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual meeting, Washington, D. C., Dec. 1 and 2, 1927.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Detroit, Mich., Jan. 9-10, 1928.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; Annual Convention, Cleveland, Ohio, Jan. 9-14, 1928.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-20, 1928.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 23-27, 1928.

THE NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS will hold its eighth annual convention Nov. 21 and 22 at Grove Park Inn, Asheville, N. C. T. Keith Légaré, Columbia, S. C., is secretary-treasurer.

THE MONTREAL BRANCH OF THE ENGINEERING INSTITUTE OF CANADA at its Oct. 5 meeting was addressed by Gilbert D. Fish, consulting engineer, New York City on welding as applied to structural steel, especially reviewing the welding tests made in 1926 at Carnegie Institute and also citing the welding to be done on a Boston & Maine R.R. bridge now under contract. Details of the welding of the joints for this bridge were shown on the screen.

THE MUNICIPAL ENGINEERS OF THE CITY OF NEW YORK were invited by the New York and New Jersey Vehicular Tunnel Commission to inspect the Holland tunnel under the Hudson River at New York on Oct. 29, the tunnel being practically completed and in condition for its opening in a few days.

THE PROVIDENCE, R. I., ENGINEERING SOCIETY took a trip Oct. 25 to Fall River, Mass., to inspect the Somerset station of the Montaup Electric Co., and the American Print Works, and in the evening had an address on "Modern Tendencies in Power Plant Design in Europe and in this Country" by George A. Orrok, consulting engineer, New York City.

THE IOWA CONFERENCE ON SEWAGE TREATMENT, ninth annual meeting, will be held at Iowa State College, Ames, Iowa, Nov. 8 to 10.

Obituary

DAVID WILLIAMS, publisher and sole owner of *The Iron Age* from 1868 to 1909, died at his home at Rogers Rock, Lake George, N. Y., on Oct. 29, aged 85 years. He was born in Waterford, Ireland, Dec. 23, 1841, and came with his parents to the United States in 1850.

REDMOND S. COLNON, president of the Fruin-Colnon Contracting Co., St. Louis, Mo., died Oct. 9 at his home in St. Louis at the age of 65 years. Born in Brownsville, N. Y., and a graduate in civil engineering from Cornell University in 1887, Mr. Colnon was for some years assistant engineer consecutively in the offices of Emil Kuichling, Rochester, and Charles H. Ledlie and Johnson & Flad. In 1892 he engaged in the contracting business for himself and since 1895 had been the partner of Jeremiah Fruin in general contracting for public works, railroad construction, commercial buildings and industrial plants. His company constructed the building of the St. Louis municipal market and garage in 1926 and has been connected with water-works construction at Chain of Rocks for St. Louis city water supply.

P. M. JOHNSTON, builder of many sections of railroad lines in the Mississippi Valley states, died recently at his home at St. Elmo, aged 80 years. The various railroad construction firms with which he was connected were Johnston Brothers, Johnston Brothers & Faught, P. M. Johnston & Co. Many hundred of miles of line were built for the following railroads; among others: Illinois Central R.R., Grand Trunk Ry., Chicago and Eastern Illinois R.R., Missouri-Kansas-Texas Ry., Chicago, Rock Island & Pacific, and the Frisco System.

JAMES H. KENNEDY, pioneer Canadian railway construction engineer, died at his home in Vancouver, B. C., on Oct. 23, in his 76th year. Mr. Kennedy was associated with Sir William Van Horne in the early days of the Canadian Pacific Ry. construction east of Winnipeg, and later joined James J. Hill on the Great Northern Ry. construction. Born at Stittsville, Ontario, Mr. Kennedy graduated in engineering from Toronto University.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Rail Steel Bar Association Meets

The Rail Steel Bar Association held its semi-annual meeting October 27 and 28 in New York City, as it has been the custom for several years to meet at the time of the sessions of the American Iron & Steel Institute.

A recently completed industrial film showing steps in the process of making rail steel reinforcing bars from the raw material, pig iron, to the finished bar, and its use in reinforced concrete construction was shown. Several copies of this film will be released immediately for exhibition to engineering and architectural societies and to universities throughout the country.

Business Notes

J. H. Somerville, who recently was connected with the Philadelphia office of the Reading Iron Co., will represent that company in the South. He has been appointed associate to W. J. White, district sales representative at Baltimore. C. M. Barr will succeed Mr. Somerville in the Philadelphia office.

Fulton Iron Works Co., Inc., has acquired a substantial stock interest in the Foos Engine Co., and H. J. Steinbreder, president of the former company, is now chairman of the board of the Foos company. This arrangement permits handling by the Fulton sales organization of a complete line of Diesel engines. Small engines will be manufactured in the Foos plant at Springfield, Ohio, and the large ones at the Fulton plant in St. Louis.

Mundy Sales Corporation has appointed the Milburn Machinery Co., Columbus, Ohio, as exclusive agents for Mundy products in Central Ohio.

George W. Ranger, works manager of the Fairmont Mining Machinery Co., Fairmont, W. Va., has resigned to become general manager of the Pulaski Foundry & Manufacturing Corporation, and the Pulaski Engineering Works, Inc., both of Pulaski, Va., and manufacturers, respectively, of cast-iron and steel machinery and of heavy plate and structural steelwork.

Wickwire Spencer Steel Co., Inc., New York City, voluntarily went into receivership under date of October 22, Edward C. Bowers and Charles L. Feldman being appointed receivers. Mr. Bowers has been for the past two years president of the corporation, and his appointment has insured the retention of the present organization which covers administration, operation and selling. All the plants will be operated as heretofore. All unfilled commitments will be handled and all sales contacts with customers will be maintained. American Wire Fabrics Corp., although a subsidiary of Wickwire Spencer Steel Co., Inc., is not affected by these proceedings.

Paul R. Price has been appointed vice-president in charge of sales of the Marquette Cement Manufacturing Co., Chicago, Ill. His appointment is of Sept. 22.

R. L. Agassiz, chairman of the Calumet & Hecla Consolidated Copper Co., was re-elected president of the Copper & Brass Research Association at the seventh annual meeting held Oct. 20 at the offices in New York City.

Chain Belt Co., Milwaukee, Wis., announces the purchase of the mortar and plaster mixer business of the Atlas Engineering Co., Milwaukee. The purchased company was organized 16 years ago and during the past three years has made admirable progress in its mixer business under the direction of H. W. Zimmermann, president.

New Developments

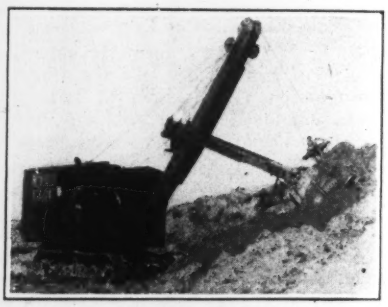
Rotary Car-Dumper Suitable for Large Construction Jobs

For dumping contractor's box-type material cars or side dump cars whose mechanism has worn out, the Roberts & Schaefer Co., Chicago, has developed a small-sized car dumper of the rotary cradle type. The car dumper is suitable for the service required at quarries, strip pits, cement plants and on large construction operations where considerable yardage of rock, gravel or earth must be moved by steam shovel operation and transported by industrial railways. It is the company's claim that there are many advantages to the use of its car dumpers in combination with solid-body cars over the operation of side-dump cars.

Steam, hydraulic, air, gravity or electric drive for the car dumper may be used. Single or multiple car dumpers are available. Single car rotary-dumpers handle standard 4 and 5-cu.yd. cars and are built to operate at a speed as high as 4 to 5 cars a minute without uncoupling any of the cars in the trip. When greater speed is required multiple car dumpers are used.

New Shovel-Crane Designed With Few Parts

When the engineers of the American Hoist & Derrick Co., St. Paul, Minn., started to design the company's new shovel-crane known as the "American Gopher," they constantly visualized a contractor with a difficult digging job far from repair facilities. The new machine has been produced to give the least possible trouble attributable to delays for repairs and is said to contain a smaller number of parts than is usual in such machines. The machine has undergone many months of trial service, before it has been announced as a new product.



The new shovel is equipped with crawler treads which are flat so as not to damage pavements. Provision is made for attaching cleats when necessary. The machine is equipped with high pressure lubrication, S.K.F. bearings and interchangeable parts wherever possible. Gasoline engine, Diesel engine, or electric motor power can be furnished. The machine is available in capacities of ¾ cu.yd. and 1 cu.yd.

New Wood Preserver Has Long Service Record in Europe

A wood preservative known as Ac-Zol, now being introduced and manufactured in this country by Zinsser & Co., Hastings-on-Hudson, N. Y., has been extensively and successfully used in Europe, especially in Belgium and France, for the past 15 years, according to the manufacturers. In the United States, its use so far has been largely for mine timbers, but some experiments and installations have been made with railroad cars and telegraph poles.

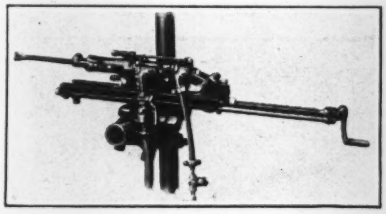
Ac-Zol is composed of ammonia, copper, zinc and phenol, combined in such a manner that they are completely

soluble during the impregnating period, becoming insoluble and firmly fixed in the wood after the treatment is completed. For most purposes, it is used in a 6 per cent solution, although for marine work this should be increased to 10 to 12 per cent.

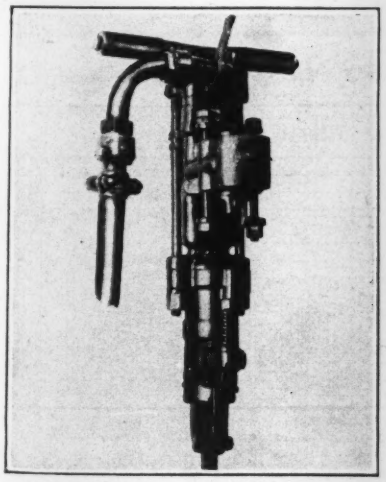
The treating may be done either by a vacuum pressure method or by a simple steaming process. The former method is quicker, gives a more thorough penetration and should be used if at all possible. In the steaming process the time of the immersion naturally depends upon the size of the piece to be treated and the density of wood, but for most practical purposes the wood should be allowed to remain in the solution for about a week. After impregnation, the wood should be allowed to dry thoroughly to allow the ammonia to evaporate. Ac-Zol is claimed to bind the wood fibers together, acting in much the same manner as might a cement, and thus to increase the mechanical strength of the wood over that obtained by a creosote treatment. It is said to be cheaper than a coal-tar preservative, and easier to apply.

Four New Drills Developed for Tunneling and Quarrying

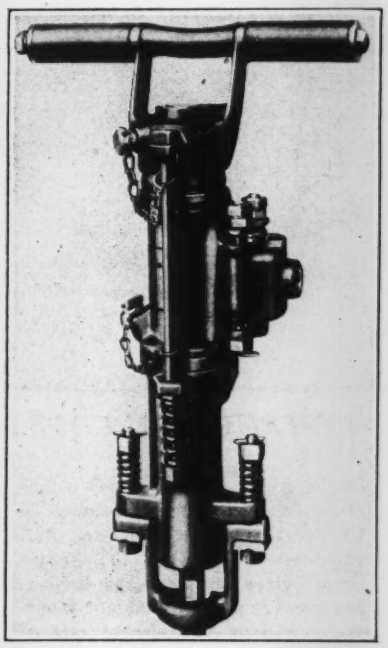
Among the new drills recently placed on the market by the Sullivan Machinery Co., Chicago, are four types of special interest to the construction field. In the order in which the illustrations appear, the first of these shown is



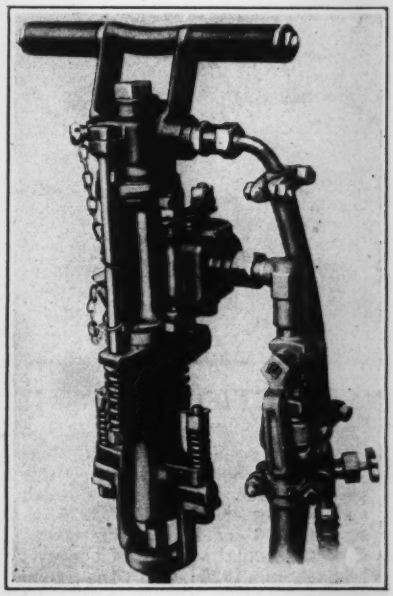
the T-3 water drifter, and is a 165-lb. machine for column, tripod or quarry bar mounting. It handles 1¼-in. round hollow steel to the customary depth needed in heavy tunneling and quarry



work. An important feature of this new machine is its ability to work satisfactorily in low air pressures such as often obtain in mining or with the



high air pressures required in modern heavy tunneling work. The second illustration shows the L-5, a medium weight sinker intended as an all around down hole machine. It handles 1-in. steel, although under favorable conditions 1⅛-in. steel may be used. Great drilling power and smoothness of operation are claimed for this type. The L-5 weighs 75 lb. and takes a 1-in. air hose.



In the third illustration is shown the L-7, and in the last the L-8 model. Both are rotating drills, the L-7 being a general purpose light rock drill suitable for all sorts of rock formation except the very softest. The L-7 uses ⅞-in. hollow steel, is equipped with a blowing device and takes ¾-in. air hose. The L-8 is designed for work in soft ground where the L-7 is too heavy to permit effective hole cleaning. This machine weighs 39 lb. and may be equipped with water tube and water hose.

The valve motion on all these new drills is similar. Rear end rifle bar rotation is also a characteristic of these new models. The front end of the piston is fluted to engage lugs in the retaining bushing through which the rotation is carried forward to the drill steel on the up or back stroke of the piston. On the forward stroke the action of the piston is unimpeded.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. Sixth Annual Show. New York City, Dec. 5-10.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; Annual Convention, Detroit, Jan. 4-6, 1928.

ASSOCIATED EQUIPMENT DISTRIBUTORS, Milwaukee; Annual meeting, Cleveland, Jan. 6-7, 1928.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; Annual Convention, Cleveland, Ohio, Jan. 9-14, 1928.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 16-19, 1928.

New Publications

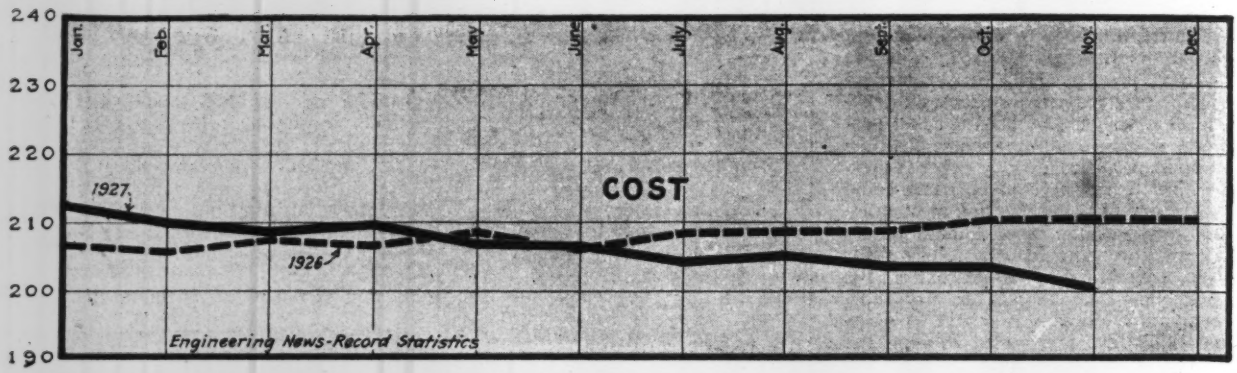
Sheet Steel Directory—SHEET STEEL TRADE EXTENSION COMMITTEE, Pittsburgh, Pa., has published its first directory of sheet steel products and fabricators. It contains over 5,000 manufacturers of sheet steel products and is meant to serve as a buyer's guide. The book is being distributed for $3.

Steel Forms — WASHINGTON STEEL FORM Co., Washington, D. C., has published a folder containing 10 pages of illustrations showing the use of its steel column and floor forms on buildings of many types.

Compressors—GARDNER-DENVER Co., formerly the Denver Rock Drill Mfg. Company, Denver, Colo., has published a new bulletin No. 200-A, describing a new line of Gardner-Denver portable compressors. The bulletin contains 15 pages, each page devoted to illustrations and specifications of the various models. In the back are illustrated and described clay spaders, concrete breakers, post drivers, steel drill sharpeners and drills.

Engineering News-Record Statistics of the Construction Industry

November 3, 1927 — *in the United States* — Vol.99, No.18



***Engineering News-Record* CONSTRUCTION COST Index Number (1913 = 100)**

MONTHLY
January, 1926, to Date

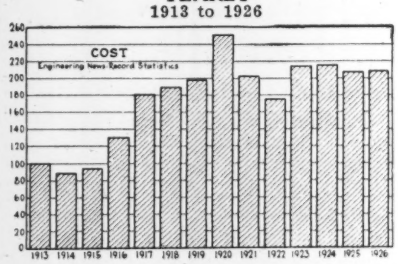
November, 1927	**201.98**
October, 1927	204.40
November, 1926	210.80
Peak, June, 1920	273.80
1913	100.00

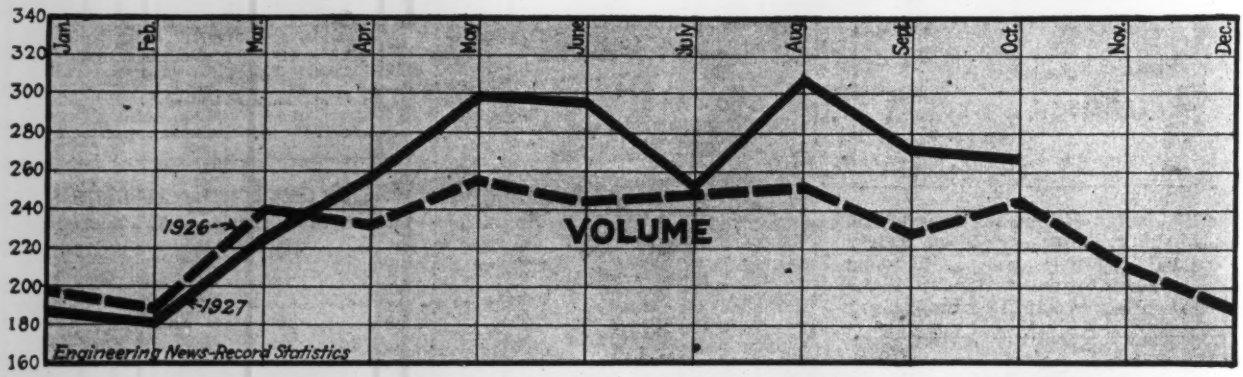
1926					
Jan.	207.15	May	207.30	Sept.	208.30
Feb.	206.55	June	204.80	Oct.	209.80
Mar.	207.65	July	207.80	Nov.	210.80
April	207.05	Aug.	208.30	Dec.	210.80

1927					
Jan.	211.50	April	209.00	July	203.68
Feb.	210.15	May	206.80	Aug.	205.53
Mar.	208.80	June	205.55	Sept.	203.60

Engineering News-Record's Construction Cost Index Number is 1.1 per cent below October, 1927. The decrease is due to slightly lower prices for steel and lumber. The average rate for common laborers is still at the October rate of 54½c. per hour. Thus, general construction cost is 4 per cent below November, 1926, and 26 per cent under the peak. It is also 101 per cent above 1913.

YEARLY
1913 to 1926





***Engineering News Record* CONSTRUCTION VOLUME Index Number (1913 = 100)**

MONTHLY
January, 1926, to October, 1927

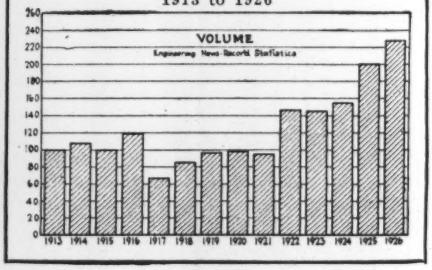
October, 1927	**269**
September, 1927	273
October, 1926	244
1913	100

1926					
Jan.	198	May	254	Sept.	227
Feb.	187	June	246	Oct.	244
Mar.	240	July	248	Nov.	211
April	233	Aug.	252	Dec.	188

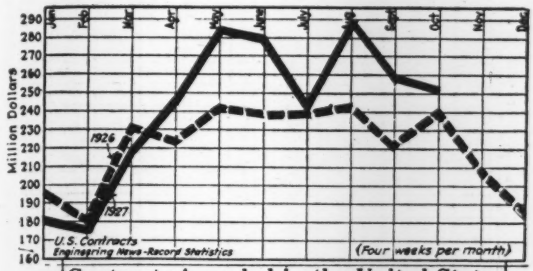
1927					
Jan.	187	April	257	July	252
Feb.	182	May	299	Aug.	306
Mar.	226	June	297	Sept.	273

Engineering News-Record's Construction Volume Index Number is 269 for the month of October and 228 for the whole of 1926, as against 100 for 1913. This means that the actual volume of contract letting in 1926 (not the mere money-value of the contracts let that year) is 128 per cent above the volume for 1913. The monthly volume number, 269 for October, 1927, indicates the rate at which contracts are being let as compared with 1913 awards.

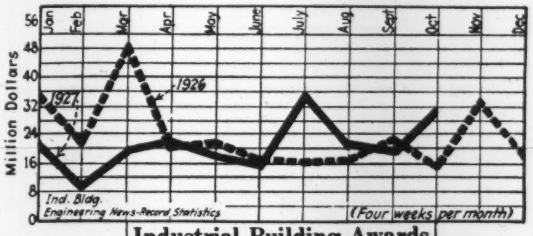
YEARLY
1913 to 1926



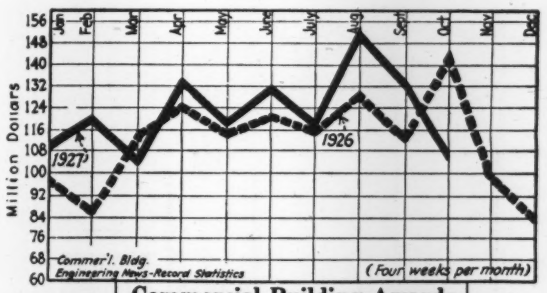
Monthly Statistics of the Construction Industry



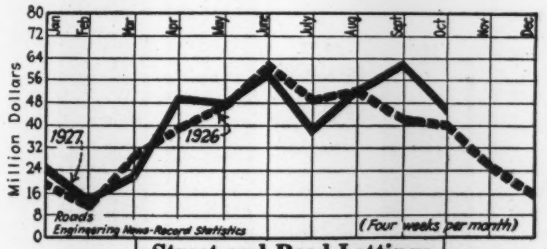
Contracts Awarded in the United States
Reported by E. N.-R.



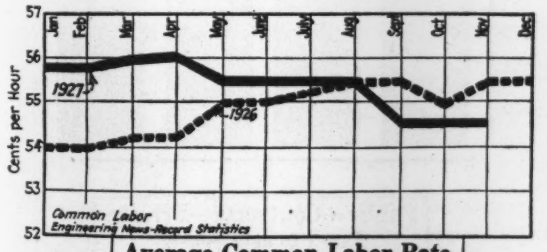
Industrial Building Awards
$40,000 and Over



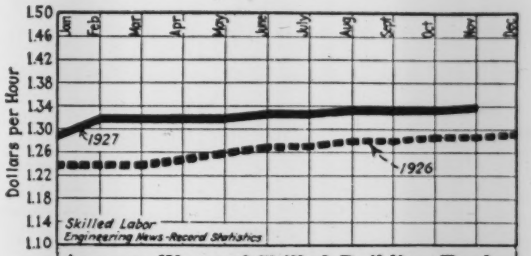
Commercial Building Awards
$150,000 and Over



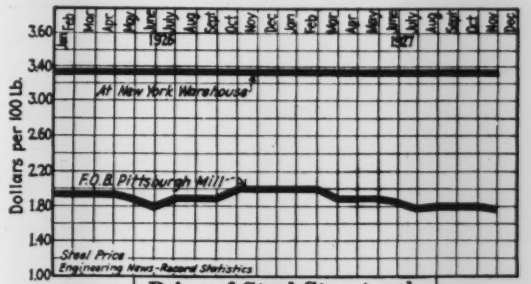
Street and Road Lettings
$25,000 and Over



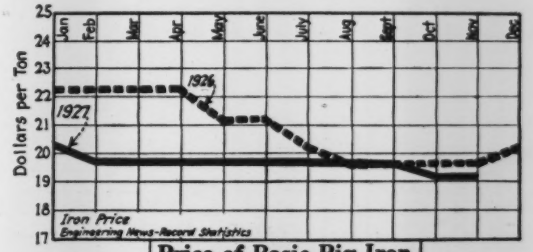
Average Common Labor Rate
Pick and Shovel Men



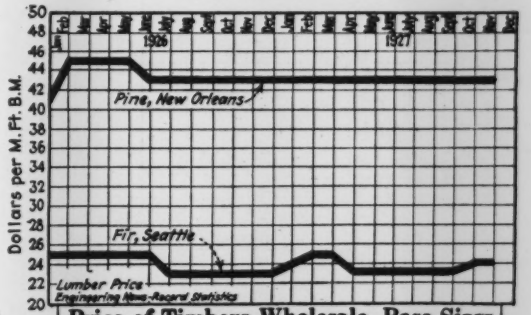
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



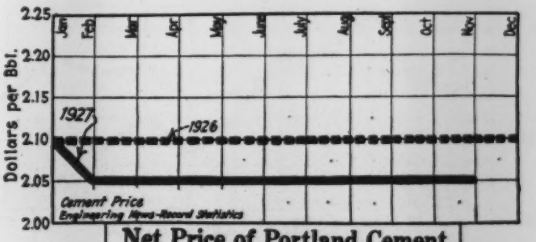
Price of Steel Structurals
Shapes 3-in; Plates ¦-in.



Price of Basic Pig Iron
F.o.b. Pittsburgh

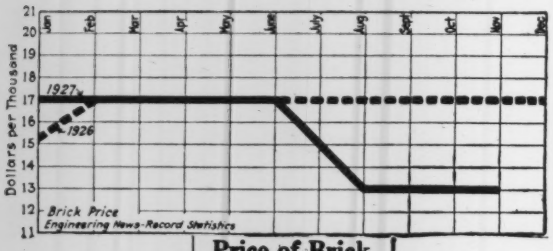


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

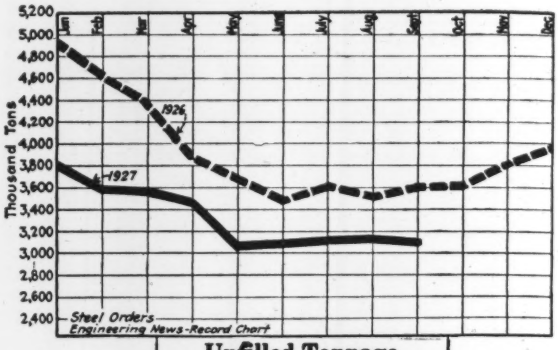


Net Price of Portland Cement
Car Lots F.o.b. Chicago

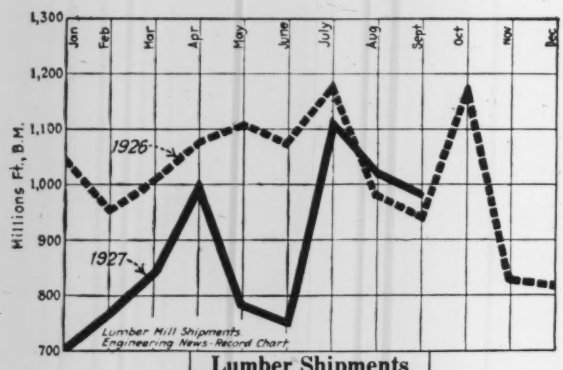
Monthly Statistics of the Construction Industry



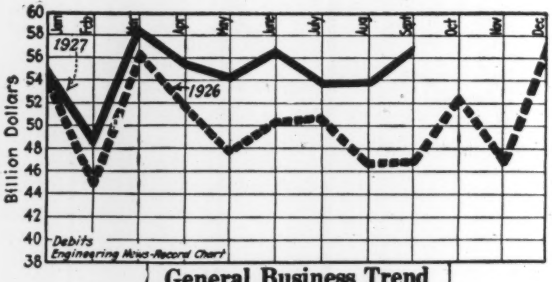
Price of Brick
At Dock, New York



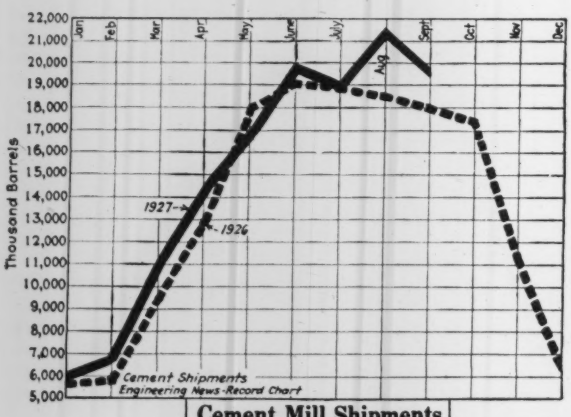
Unfilled Tonnage
On Books of U. S. Steel Corp.



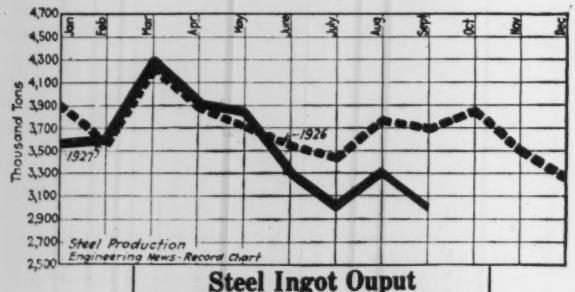
Lumber Shipments
Nat. Lumber Mfrs. Assn.



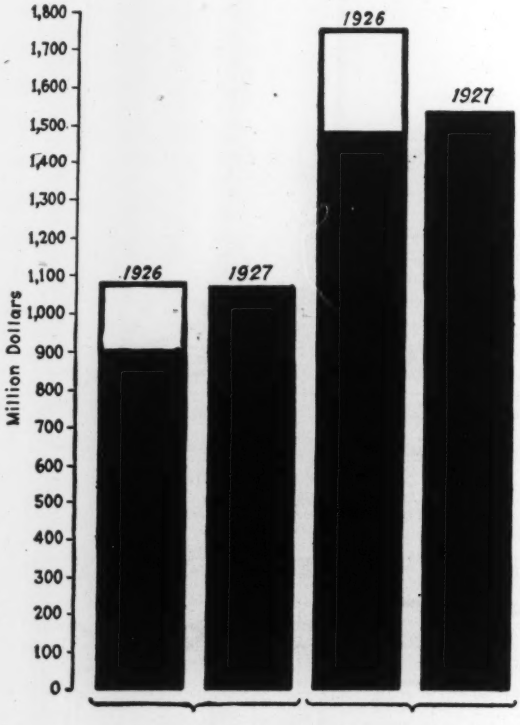
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Shipments
Bureau of Mines



Steel Ingot Ouput
Gross Tons; Am. Iron and Steel Inst.



Public—Contracts—Private
Jan. 1 to date ——
Reported by E. N.-R.

Volume of 1927 Contract Letting Ahead of Last Year to Date

Heavy Gain In Construction Other Than Buildings

MONEY value of engineering construction contracts awarded in the United States during October, was 5 per cent greater than the total of lettings for the corresponding month last year, according to *Engineering News-Record* statistics. Costs, moreover, are at least 4 per cent below levels of a year ago.

Total contract value for the first ten months this year, is more than $200,000,000 ahead of the same period in 1926.

Comparison of weekly lettings, with those of September, 1927, shows a decline of 2.1 per cent in the October rate. This is close to the normal decline of 2.7 per cent for any October, compared with the month preceding, as determined by a study of seasonal variations over a period of fourteen years—1913 to 1926.

The figures shown in the accompanying table are based on a minimum for each class, as follows: water-works, and excavation, drainage, irrigation, levee, river, and harbor projects, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial, educational, institutional, religious, and other buildings, $150,000.

Public work in October, 1927, represented 46 per cent of the total value of contracts for that month, as against 35 per cent, for the same period last year.

The gain in amount of public work awarded, is significant, in that the chief danger of over-building lies in the direction of privately-owned structures, residences particularly.

Privately-owned commercial building awards ($150,000 and over) for the period Jan. 1 to Nov. 1, 1927, total $1,125,912,000 as against $1,085,485,000, for the same months in 1926; a gain of $40,427,000.

Public building awards ($150,000 and up) for the ten months this year, total $196,459,000, compared with $176,783,000 for the corresponding period last year; an increase of $19,676,000.

Industrial building awards ($40,000 and over) amounted to $228,336,000 for the period Jan. 1 to Nov. 1, 1927, against $258,507,000 for the corresponding months in 1926; a loss of $30,171,000.

Construction other than buildings, reached a total contract value of $1,067,893,000 for the first ten months of this year, as compared with $894,587,000 for the same part of 1926; a gain of $173,306,000.

The foregoing figures show a gain of over $40,000,000 in commercial buildings, in contrast with a loss of more than $30,000,000 in industrial work.

While the volume of industrial contract letting indicates a lack of further plant expansion, it also draws attention to a comparison of present conditions with those of the panic year 1907.

Twenty years ago, inflation existed mainly in industrial building and the stock market. Today it takes the purely financial forms—stocks, bonds, investment securities, and real estate mortgage holdings.

VALUE OF CONTRACTS BY SECTIONS IN THE UNITED STATES AND TOTAL FOR CANADA—OCTOBER, 1927
Thousands of dollars (-000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Nov. 1, U. S.	Canada
Waterworks	$66	$381	$674	$850	$689	$337	$2,997	$47,334	$94
Sewers	97	851	557	9,267	3,144	969	14,885	102,210	246
Bridges	136	10,911	2,860	1,393	1,226	954	17,480	119,651	3,147
Excavations, drainage, etc.	519	115	355	483	170	864	2,506	39,349	1,206
Streets and roads	1,170	10,975	5,204	9,361	12,317	7,491	46,518	456,578	83
Industrial buildings	1,918	10,444	3,744	4,567	2,287	7,759	30,719	228,336	11,500
Commercial buildings	5,169	39,316	7,442	27,072	10,922	16,994	106,915	1,322,371	8,764
Federal government	21	2,219	936	169	383	2,355	6,083	43,400	.....
Unclassified	264	6,273	222	100	15,453	1,573	23,885	259,371	4,755
October, 1927	9,360	81,485	21,994	53,262	46,591	39,296	251,988	.....	29,795
September, 1927	25,720	72,966	34,326	*97,731	54,184	36,712	*321,639	.....	12,122
October, 1926	14,028	74,974	16,035	77,017	18,358	38,432	238,844	.....	5,291
Jan. 1 to Nov. 1, 1927	197,589	778,686	207,624	647,601	462,654	324,446	2,618,600	2,618,600	118,332
Jan. 1 to Nov. 1, 1926	203,318	737,968	242,660	610,059	357,240	264,117	2,415,362	2,415,362	100,387

* Revised figures.

Labor Rates and Conditions Throughout the Country

Skilled Wage Schedules To Hold For Remainder of 1927

FEW strikes or wage controversies mark the mid-autumn labor market in the construction trades, according to reports received by *Engineering News-Record.*

Apparent recession in speculative building may have much to do with the present condition of tranquillity, to which only two outstanding exceptions appear.

The two exceptions are: the recent strike of plasterers at Philadelphia, Pittsburgh, and Baltimore; and the jurisdictional dispute among carpenters in Toronto, Canada.

Trouble in both crafts resulted from refusal of employers to grant open-shop conditions.

Wage rates in the building trades, will, to all appearances, hold at present levels for the remainder of 1927.

Principal developments during the month, in various sections of the country, were as follows:

New York—City engineers, to the number of 3,700, presented demands, Oct. 22, to the Board of Estimate, for advance of 35 per cent in salary.

St. Louis—Employers adopt resolution against five-day week plan endorsed recently by the electrical workers, lathers, and plasterers.

Detroit—Surplus of all trades, particularly in the automotive industry. Employers' Association reports reduction in employment, of 37,000 workers.

Cleveland — Marked unemployment throughout Ohio. Contiguous territory, however, reports improvement in demand for labor.

Baltimore—Union wage rates rejected on all new State building jobs.

Syracuse, N. Y. — Plasterers and cement finishers signed wage agreements with employers for 1928.

Ottawa, Canada — Elevator installation men on strike throughout the Dominion.

Following are building trades wage rates in crafts other than those included in the table on p. 736, the lower figure in each case applies to open-shops:

CHICAGO

Trade	Rate per Hour
Architectural ironworkers	$1.50
Asbestos workers	1.56½
Boiler makers	1.50
Bricklayers, fireproofers	1.65
Caisson men, diggers	1.20
Caisson men, windlass, niggerhead	1.05
Cement finishers	1.10@1.50
Composition floor finishers	1.50
Composition floor laborers	.93¾
Electrical workers	1.62½
Elevator constructors	1.57½
Elevator constructors' helpers	1.10
Fixture hangers	1.62½
Gas fitters	1.15@1.50
Glaziers	1.15@1.62½
Lathers	1.12½@1.62½
Machinery movers and riggers	1.40
Marble setters	1.50

Current Building Trades Wage Rates Per Hour

(Higher rates than a month ago indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.40	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.62½	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.40
Birmingham	1.00@1.50	1.05	1.00	.50@.75	.....	1.75	.25@.40
Boston	1.40	1.25	1.25	.79	1.15	1.25	.45@.74
Cincinnati	+1.37½	+1.37½	+1.37½	.97½	+1.37½	+1.37½	.45@.60
Chicago	1.62½	1.10@1.50	1.00@1.50	.90@.96¼	1.50	1.50	—.82½@.90
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.87½
Dallas	1.62½	1.12½	1.00	.40@.75	1.00	1.25	.30@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	....	1.25	.31¼@.50
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City, Mo	1.50	1.25	1.25	.90	1.25	1.25	.35@.75
Los Angeles	1.37½	1.00	1.00	.86½	1.18½	1.00	.50
Minneapolis	1.25	.87½@95	.87½	.75	....	1.00	.45@.60
Montreal	1.25	.75	.75	.40	.50	+1.00	.30@.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90⅝
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.50
Pittsburgh	1.70	1.50	+1.50	1.12½	....	1.50	.50@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	+.50@.75
San Francisco	1.37½	1.12½	1.00@1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½@1.25	.62½@.70

Trade	Rate Per Hour
Marble setters' helpers	$1.05
Mosaic and tile setters	1.62½
Mosaic and tile setters' helpers	1.00
Painters	.95@1.62½
Plasterers	1.62½
Plumbers	1.25@1.62½

Trade	Rate Per Hour
Roofers, composition	$1.10@1.50
Roofers, slate	1.15@1.75
Sheet metal workers	1.15@1.50
Sprinkler fitters	1.62½
Sprinkler fitters, helpers	.85
Steam fitters	1.62½

Trade	Rate Per Hour
Stone carvers	$1.75
Stone cutters	1.50
Stone derrick men	1.15
Stone planermen	1.17½
Terrazzo mechanics	1.50
Tuck pointers	1.62½

Monthly Prices of Construction Materials

Cast-Iron Pipe and Steel Structurals Down—No Further Drop In Cement

SEASONAL decline in production is in evidence throughout the entire building materials manufacturing industry.

Orders, shipments, and reserve stocks, with few exceptions, show the recessions necessary in order to prevent marked price fluctuations.

The present tendency to restrict materials stocks and, at the same time, to reduce prices, is obviously a safeguard against repetition of the inflationary conditions which characterized the 1919-1920 period.

The exceptions referred to, are stocks of burned brick at yards throughout the country, and shipments of hardwood and softwood lumber. Orders for the principal softwoods are increasing with consequent firmness in current prices.

Compared with a year ago, the volume of business in structural steel and hardwood lumber is measurably smaller. The common brick movement, however, is substantially above that of 1926. Softwood lumber and portland cement, both show heavier production and shipments than at this time last year. Demand for softwoods, and mill stocks of portland cement, are below respective 1926 levels.

The foregoing conclusions are drawn from latest data, submitted by the various manufacturers' associations, the Federal Government and *E. N-R.* correspondents. Sources are as follows: Steel ingot output—American Iron and Steel Institute; unfilled steel tonnage—United States Steel Corporation; lumber shipments, production and orders—National Lumber Manufacturers' Association; brick stocks movements from yards, and orders—Common Brick Manufacturers' Association of America; cement production, shipments, and mill stocks—Bureau of Mines.

It is unnecessary to show the actual figures, especially since interest is centered mainly in the effect that these materials movements have upon price. Major changes of the last thirty days are designated on pp. 737 to 740.

Orders in excess of available supplies, have had the effect of advancing prices for re-rolled rails, structural rivets, lumber, and manila rope, at various important points throughout the country, over October levels in these materials.

Various fluctuations of a purely local nature, occurred during the last month, such as the following: Lime prices advanced at Boston and receded in Atlanta; sewer pipe rose in New Orleans and declined at Philadelphia.

Many important materials followed the downward trend, so much in evidence during the last few months. Principal among these were: Iron and steel scrap, track bolts, brick, tile, nails, steel sheets, linseed oil, cast-iron pipe, and steel shapes.

Cast-iron Pipe—Prices fell $2 per ton during October at the principal consuming centers. Class B pipe, 6-in. and over, base, Birmingham, is now $28 per ton as against $40, in November, 1926.

Steel—Structural shapes and plates, base, Pittsburgh, sell at a maximum of $1.75 per 100 lb., as against $1.85, one month ago. Reinforcing bars, ¾-in., billet steel, remain at the October level of $1.75@$1.85 per 100 lb., f.o.b., mill.

Cement—The price decline that started about a month ago, at Detroit, has evidently been stemmed. A total of forty-five localities, that report regularly to *E. N-R.*, show no appreciable change in November cement quotations, compared with those of last month.

Special Tabulation of Unit Prices

Earth Excavation

These unit prices were included in low bidders' estimates on various sections of subway work in New York, Brooklyn, Flushing, Philadelphia, and Rochester, 1922 to date:

Location	Date	Cu.Yd.	Price per Cu.Yd.
Flusning	Nov., 1922	126,550	$4.40
Brooklyn	Jan., 1923	46,500	6.20
		175,000	3.70
Rochester	July, 1923	230,000	1.40
Philadelphia	Sept., 1923	70,000	8.25
Brooklyn	Oct., 1923	175,000	4.08
	May, 1924	196,050	6.90
	Oct., 1924	179,500	7.50
	Nov., 1924	660,000	10.70
New York	Feb., 1925	190,000	12.00
	June, 1925	186,000	9.00
		86,000	6.50
Philadelphia	Aug., 1925	600,000	7.30
New York	Aug., 1925	44,000	12.00
	Oct., 1925	22,800	11.00
	Nov., 1925	132,000	12.85
	Jan., 1926	200,000	12.50
	Feb., 1926	135,000	12.15
New York	Mar., 1926	75,200	10.40
		121,000	12.00
New York	July, 1926	3,000	12.00
Brooklyn	Aug., 1926	78,500	7.10
New York	Sept., 1926	125,000	10.20
New York	Oct., 1926	6,600	15.00
New York	Oct., 1926	23,550	17.00
New York	Dec., 1926	433,500	6.70
New York	Mar., 1927	12,000	11.00

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton, f.o.b.:

	Nov. 3	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	$21.44	$24.19
Northern Basic	20.89	20.39
No. 2 Southern Ohio (silicon 1.75@2.25)	21.19	21.39
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	25.62	26.37
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	17.75	20.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	21.76	22.76
Virginia No. 2 (silicon 2.25@2.75)	27.17	28.17
Basic	21.26	21.26
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	21.00	21.00
No. 2 Foundry Southern (silicon 2.25@2.75)	22.80	24.55
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	20.26	20.26
Basic	*19.26*	19.76
Bessemer	21.26	20.76

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York	Chicago
No. 1 railroad wrought	*$11.00@$11.50*	*$10.00@$10.50*
Stove plate	*9.00@ 9.50*	*12.00@ 12.50*
No. 1 machinery cast	12.50@ 14.00	*14.00@ 14.50*
Machine shop turnings	*7.00@ 7.25*	*6.75@ 7.25*
Cast borings	*7.25@ 7.50*	*9.00@ 9.50*
Railroad malleable	10.25@ 10.75	*11.75@ 12.25*
Re-rolling rails	10.25@ 10.75	*13.00@ 13.50*
Re-laying rails	23.00@ 24.00	.....
Heavy melting steel	*6.75@ 10.75*	*10.25@ 10.75*
Iron and steel pipe	8.75	.....

Railway Supplies

STEEL RAILS—The following quotations are per gross ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Nov. 3	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	.....
Standard openhearth rails	43.00	43.00	43.00	43.00	$49.50
Light rails, 8 to 10 lb.	.....	.....	34@36	1.80@1.90*	1.90*
Light rails, 12 to 14 lb.	.....	.....	34@36	1.80@1.90*	1.80*
Light rails, 25 to 45 lb.	36.00	36.00	34@36	1.80@1.90*	1.78*
Re-rolled rails	30@34	27@30	34@36	34@36	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.45	$1.83
Chicago, empty cell creosoted	1.85	2.45
Chicago, zinc treated	1.65	2.15
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.25	1.50
St. Louis, zinc treated	1.65	1.90
St. Louis, red oak, plain	1.15	1.40
St. Louis, sap pine-cypress	1.00	1.25
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Nov. 3	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$2.80	$2.80@2.90	$3.55	$3.65	$3.85	$3.00
Track bolts	*3.80*	3.90@ 4.25	4.55	4.60	5.35	3.90
Standard section angle bars, splice bars or fish plates	2.75	2.85@2.95	3.40	3.75	4.25	2.95
Tie plates	2.25	.....	....	....	....	....

Pipe

WROUGHT STEEL AND IRON PIPE—The following discounts from list are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1¼	30	13
LAP WELD					
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	45½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	60	49½	1 to 1¼	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT-STEEL PIPE—From warehouses at the places named the following discounts from list, hold for welded steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	54%	49%
2½ to 6 in. lap welded	48%	51%	46%
	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	39%	41%	36%
2½ to 6 in. lap welded	35%	38%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36 – 5% off.

CAST-IRON PIPE—The following are prices per net ton for Class B and heavier, f. o. b., in carload or larger lots:

	Birmingham	Burlington, N. J.	New York Nov. 3	New York One Year Ago
4 in.	*$42.00*	*$42.00*	*$44.60*	$55.60@56.60
6 in. and over	*28.00*	*38.00*	*40.60*	51.60@52.60
	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	*$40.50*	*$40.00*	*$37.60*	*$43.00*
6 in. and over	*36.50*	*36.20*	*33.60*	*39.00*

Gas pipe and Class "A," $4.00 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Nov. 3	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$45.00	$45.00	.....	$45.00	.....	$73.00
4	56.00	55.00	$35.00	56.00	$76.50	90.00
5	.....	.....	.....	80.00	97.75	118.00
6	80.00	90.00	65.00	100.00	127.50	150.00
8	150.00	160.00	150.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.072	$0.10	.....	$0.088	$0.12	.....
4	.....	.072	.10	$0.0875	.088	.15	$0.15
5	.....	.099	.135	.....	.11	.18	.18
6	$0.22	.099	.21	.1225	.11	.21	.21
8	.36	.162	.315	.20	.18	.30	.38
10	.52	.2415	.45	.28	.2625	.42	.53
12	.66	.3105	.54	.36†	.3375	.56	.70
15	1.12†	.414	.75	.60†	.45	.92	1.01
18	1.62†	.575	.90	.84†	.825†	1.32	1.32
20	1.95†	.69	1.20	.....	1.05†	.....	.....
21	.....	.805	.....	1.12†	1.225†	.....	.....
22	2.60†	.92	1.35	.....	1.40†	.....	1.83
24	2.92†	1.035	2.665	1.44†	1.575†	2.16	2.27
27	4.62†	2.08	2.952	2.45†	2.75†	3.00	3.34
30	5.12†	2.304	3.96	3.00†	3.75†	3.60	4.06
33	6.93†	4.05	4.51	3.55†	4.50†	.....	4.99
36	7.91†	4.6125	5.06	3.95†	5.00†	.....	5.42

	3	5	8	12	24	36
Boston	$0.125	$0.175	$0.25	$0.47	$1.80†	$5.10†
Minneapolis	.....	.....	.25	.45	1.50	4.56
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14	.....	.35	.63	2.52	.....
Los Angeles	1675	.186	.2825	.5085†	2.034†	.....
New Orleans	**.11***	**.165***	**.275**	**.4675**	**1.7875**	3.50
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	.....
Montreal	.....	.25	.45	.675	2.25	.....
Detroit	.081	.122	.189	.405	2.07†	4.715†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15*	.21*	.29	.52	1.90†	3.80†
Philadelphia	*.10*	*.14*	*.235*	*.38*	*1.33*	*3.32½*

*4-in., 6-in., 9-in., respectively. †Double Strength.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. places named:

		Nov. 3	One Year Ago
New York, 45% asphalt	(at terminal)	$0.0725@$0.075	$0.065 @$0.07
New York, 65% asphalt	(at terminal)	.0675@ .0725	.0675@.0725
New York, binder	(at terminal)	.07 @ .075	.07 @.075
New York, flux	(at terminal)	.07 @ .075	.07 @.075
New York, liquid asphalt	(at terminal)	.07 @ .075	.07 @.075
St. Louis, 40@50% asphalt		.052	.053
St. Louis, 50@60% asphalt		.0554	.0525
Birmingham, 55% asphalt		.0475	.0475
Dallas, 45% asphalt		.0495	.0495
Dallas, 50% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		12.00*	12.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$24.50	.....
Boston (*Mexican*)	23.50	$19.00
Chicago (*Texas*)	24.00	18.50
San Francisco, *f.o.b. refinery*, Oleum, Cal.	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, *"D" grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	.....
Minneapolis, *f.o.b. Twin Cities* (*Stanolind*)	28.10	22.10
St. Louis (*Mexican*)	26.00	23.00
Baltimore (*Standard Oil*) (*f.o.b. refinery*)	22.50	18.50
Montreal (*Imperial*)	27.00	22.50
Atlanta (*Mexican*)	24.40	19.40
Detroit (*Mexican*)	24.00	19.00
Cincinnati (*Kentucky Rock*)	.....	11.65
Maurer, N. J. (*Bermudez*)	30.00	.....
Maurer, N. J. (*Trinidad*)	23.00	.....
Philadelphia (*Mexican*)	20.00	18.00
Kansas City, Mo. (*Texas*)	28.30	23.30
Los Angeles (*"D" grade, California*)	*18.00	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	20.00	17.00

*F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$150.00 per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd.
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	2.75 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 90c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., 90c. per lin.ft.; roundings, $1.55. *Birmingham*: Limestone, 5x18-in., $1.05 per lin.ft.

WOOD BLOCK, PAVING—

	Size of Block	Treatment	Per Sq. Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.40
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.25
St. Louis	4	16	2.50
Seattle	4	16	Off market
Minneapolis	3½	16	2.50
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Cincinnati	3½	16	2.35
Kansas City	4	16	2.50
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractors, f.o.b., per cu.yd. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd. unless otherwise specified in pounds.

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Nov. 3	One Year Ago	Nov. 3	One Year Ago	Nov. 3	One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver (*2,700*)	1.90	1.90	1.90	1.90	1.00	1.00
Chicago (*3,000*)	2.00*	1.85	2.00*	1.85	2.00*	1.65
St. Louis	1.45†	1.45†	1.45†	1.45†	1.20†	.93‡
Seattle (*3,200*) (*2,800*)	1.25	1.50	1.25	1.50	1.25	1.50
Dallas (*3,000*)	2.38*	2.38*	2.38*	2.38*	2.00*	2.00*
Minneapolis (*2,800*)	1.25†	1.65†	1.25†	1.65†	1.25	1.25
Cincinnati	1.30†	1.30†	1.30†	1.30†	1.05†	1.05†
San Francisco (*2,800*)	1.80	1.80	1.80	1.80	1.40	1.40
Boston (*on trucks at dock*)	1.75†	1.50†	1.75†	1.50†	1.25†	1.00†
New Orleans	1.95	.....	1.95	.....	1.40	1.80†
Los Angeles	2.00†*	1.95†	2.00†*	1.95†	1.40†	1.70†
Atlanta	2.20†*	1.90†	2.20†*	1.90†	1.75†	1.60†
Detroit (*2,600*)	1.70	1.45†	1.60	1.35†	1.35	1.10†
Baltimore	1.40	1.40	1.60	1.60	.70‡†	.70‡†
Montreal	1.90†	1.25†	1.90†	1.50†	1.35†	1.25†
Birmingham (*2,700*)	1.54	2.00*	1.54	2.00*	1.19	1.50
Philadelphia (*2,950*)	2.25*	2.10*	2.25*	2.10*	1.65	1.50
Kansas City, Mo.	.....	.....	.....	.....	.66‡†	.66‡†
Pittsburgh	.85‡	....	1.05†	....	1.25	....

*Delivered †Per ton. ‡At pit. Note: New York in truckload lots; gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Prices are for cargo or carload lots, per cu.yd., f.o.b. city. Weight 1½ tons per cu.yd., unless otherwise specified in pounds:

	1½ In.		¾ In.	
	Nov. 3	One Year Ago	Nov. 3	One Year Ago
New York (*L*)	$1.75	$1.84	$1.85	$1.94
Chicago (*L*)	2.00†	1.70	2.00†	1.87½
St. Louis	1.83*	1.83*	1.83*	1.93*
Dallas (*2,500*)	2.40†	2.40†	2.83†	2.83†
San Francisco (*T*) (*2,400*)	1.70	1.70	1.70	1.70
Boston (*on trucks at dock*)	2.00*	1.60*	2.00*	1.60*
Minneapolis (*L*) (*2,600*)	1.25*	1.75	1.25*	1.75
Kansas City (*L*) (*2,450*)	2.00†	2.00†	2.00†	2.00†
Denver (*G*) (*2,700*)	2.50†	2.50†	2.50†	2.50†
Seattle (*3,000*)	2.50†	3.00†	2.50†	3.00†
Atlanta	2.50*†	2.50*†	2.50*†	2.50*†
Cincinnati	1.65*	1.65*	1.65*	1.65*
Los Angeles	2.00*†	2.10*†	2.00*†	2.10*†
Detroit (*L*) (*2,600*)	2.60*†	1.85@2.00*†	2.60*†	1.85@2.00*†
Baltimore	2.50†	2.50†	2.55†	2.55†
Montreal	1.80*	1.80*	2.00*†	2.00*†
Philadelphia (*L*) (*2,590*)	2.25†	2.10†	2.25†	2.10†
Pittsburgh	2.75*†	2.85†	2.75*†	2.85†
Cleveland	2.70*†	2.70*†	2.70*†	2.70*†
Birmingham (*L*)	.85‡	2.00†	1.00‡	2.00†

*Per ton. †Delivered. ‡At Crusher. *L*-Limestone. *G*-Granite. *T*-Trap rock. Note: New York in truck-load lots.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Buffalo District	1.25	1.35	2.25	1.25
Birmingham, Ala.	.90	1.25	2.05	.80
Cleveland, Ohio	1.20	1.20	.....	1.30*
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25

*Includes freight charge.

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$19.45	$12.10	$3.50*	$2.35@2.50*
Chicago	20.00	18.00	.....	1.50†
St. Louis	23.50	17.50	.....	2.03*
Boston	18.50	11.00	3.50*	2.25@2.65*
Dallas	19.00	.....	.....	1.82†
Cincinnati	16.80	11.90	.....	11.40‡
San Francisco	27.50	24.00	.....	1.70†
Minneapolis	25.50	21.00	.....	1.70†
Denver	24.00	.....	.....	2.70*
Detroit	15.50	11.50	.....	12.00‡
Seattle, *paper sacks*	24.00	.....	.....	2.80*
Los Angeles	26.00	18.00	2.40†	14.00‡
Baltimore	24.25	17.85	2.55†	.....
Montreal	.....	21.00	.....	10.00‡
Atlanta	*21.50*	*12.50*	.....	*1.25†*
New Orleans	.....	.....	.....	2.00*
Philadelphia	23.00	15.00	.....	.....
Kansas City	19.00	17.50	2.40†	1.85†
Birmingham	22.50	16.00	2.40†	1.85†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Nov. 3	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.35	1.45
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.25	2.65
St. Louis (Carney)	2.85	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.40

PORTLAND CEMENT—Prices to contractors, per bbl. in carload lots, f.o.b. points listed, *without charge for bags*. Cash discount not deducted.

	Nov. 3	One Month Ago	One Year Ago
New York, del. by truck	$2.35	$2.35	$2.50@$2.60
New York, alongside dock to dealers	2.03	2.03	2.15
Jersey City	2.13	2.13	2.33
Boston	2.05	2.05	2.30
Chicago	2.05	2.05	2.10
Pittsburgh	2.04	2.04	2.09
Cleveland	2.24	2.24	2.29
Detroit	2.00	2.00	2.15
Indianapolis	2.19	2.19	2.29
Milwaukee	2.20	2.20	2.25
Duluth	2.04	2.04	2.09
Peoria	2.22	2.22	2.27
Cedar Rapids	2.24	2.24	2.34
Davenport	2.24	2.24	2.29
St. Louis	2.05	2.05	2.20
San Francisco	2.51	2.51	2.31
New Orleans	2.32	2.32	2.30
Minneapolis	2.22	2.22	2.32
Denver	2.85	2.85	2.85
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.45	2.40	2.35
Cincinnati	2.32	2.32	2.37
Los Angeles	2.56	2.56	2.20
Baltimore	2.50	2.50	2.50
Birmingham	2.40	2.40	2.40
Kansas City, Mo.	2.07	2.07	2.35
Montreal	1.41	1.41	1.41
Philadelphia	2.40	2.40	2.41
St. Paul	2.22	2.22	2.32
Toledo	2.20	2.20	2.20

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.80	Hudson, N. Y.	$1.75
Universal, Pa.	1.80	Leeds, Ala.	1.65
Steelton, Minn.	1.85	Hannibal, Mo.	1.90
Fordwick, Va.	2.05	Lehigh Valley District	1.75
Mitchell, Ind.	1.90	Wyandotte, Mich.	1.75
Iola, Kan.	1.85	Alpena, Mich.	1.60
Mason City, Ia.	1.80	Kingsport, Tenn.	2.05
La Salle, Ill.	1.90		

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots at mills; from warehouse in less-than-carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
052	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
058	35	1.54	1.58	2.16	1 66	1.67	1.91
093	45	1.98	2.03	2.77	2.13	2.00	2 46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.11	3.14	3.15	.....
180	78	3.35	3.43	5.70	3.60	3.47	.....
245	103	4.43	4.53	6.21	4.75	4.58	.....
287	119	5.12	5.24	7.19	5.50	5.26	6.35
336	138	5.93	6.07	8.35	6.37	6.11	.....
395	160	6.88	7.04	9.65	7.38	7.12	.....
		PAVING					
036P	17	$0.76	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.07	1.09	1.50	1.14	1.07	.....
072P	31	1.35	1.38	1.90	1.45	1.39	.....
097P	40	1.74	1.78	2.45	1.87	1.90	.....
049R	24	1.07	1.09	....	1.14	1.02	.....
067R	31	1.35	1.38	....	1.45	1.39	.....
089R	40	1.74	1.78	....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in less-than-carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$17.50	$19.50	$17.50	$16.50	$17.00	$24.00
2.5	18.50	21.50	18.50	17.50	19.00	26.00
3.0	21.00	24.50	21.00	20.00	22 00	29.00
3.4	22.50	27.50	22.50	21.50	24.00	31.00

BARS, CONCRETE REINFORCING—Price per 100 lb., in carload lots, f.o.b. mill, Pittsburgh and Birmingham. ,In other cities listed, prices are for bars out of stock at warehouse.

ROLLED FROM BILLETS

Inches	Pittsburgh	Birmingham	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.75@$1.85	$2.00	$3.24	$2.50	$3.15	$2.75	$2.95
⅝	1.85@ 1.95	2.10	3.34	2.60	3.25	2.85	3.05
¾	1.95@ 2.05	2.20	3.44	2.70	3.35	2.95	3.15
⅞	2 15@ 2.25	2.40	3.64	2.90	3.55	3.10	3.35
1	2.75@ 2.85	3.00	4.24	3.50	4.15	3.75	3.95

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ in and larger	$2.25	$2.48	⅝	$2.65	$2.88
⅝	2 35	2.58	¾	3.25	3.48
¾	2.45	2.68	....	....	.....

BRICK—Contractors price, f.o.b., per M, in cargo or carload lots, is as follows:

	Common: Nov 3	Common: One Month Ago	Common: One Year Ago	Paving: 3x8½x4-in.	Paving: 3½x8½x4-in.
New York (del.)	$16@18	$16@18	$20.40@22.40	$45.00†	$51.00†
New York (at dock)	13.00	13.00	17.00	.....	.....
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	15.00	15.00	15.00	40.00	42.50
Denver, salmon	8@12	8@12	9@10	.....	.....
Dallas	13 60	13.60	14.10	35.00	.....
San Francisco	14.00	14.00	15.00	.....	.....
Los Angeles	10.00	10.00	10.00	(not used)	
Boston (del.)	18.00	18.00	19 00	45.00	50.00
Minneapolis (del.)	13 75	13.75	13 75	.....	.....
Kansas City	14 00	14.00	14.50	(no market)	
Seattle	14.00	14.00	15.00	.....	55.00
Cincinnati	15.50	15.50	15.50	40.00	45.00
Montreal (del.)	20.25	20.25	20.25	100.00‡	.....
Detroit (del.)	15.50	15.50	14.00	35.25	38.50
Baltimore	18.00	18.00	18.00	40.00	45.00
Atlanta	*11.50*	12.50	12.00	40.00	.....
New Orleans	13.00	13.00	15.00	60.00	75.00
Birmingham	14.50	14.50	14.50	40.00	45 00
Philadelphia	18.00	18.00	18.00	40.00	50.00
Pittsburgh (del.)	17.00	17.00	16.00	.....	.....
Cleveland	14@16	14@16	12@14	.....	.....

* By truck. † In cars. ‡ Imported.

HOLLOW TILE—Price per block in carload lots, f.o.b., to contractors, for hollow building tile.

	New York: Nov. 3 on Trucks*†	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.0966	$0.1027	$0.076	$0.105	$0.068	$0.108	.....
6x12x12	.145	.1541	.104	....	.09	.156	.....
8x12x12	.1812	.1926	.142	.21	.126	.244	.....
10x12x12	.....	....	.182	....	.158	.....	$0.2388
12x12x12	.....	....	.202	.32	.186	.....	.2956

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.08	$0.14	$0.24
Minneapolis	.072	.125	.225
Cincinnati	.064	.1295	.1726
Kansas City	.088	.158	.242
Denver	.085	.155	.22
Seattle	.10	.18	.26
Los Angeles	.085	.172	.285
New Orleans	.0808	.1516	.2232
Detroit	*.068*	.1326	.1853
Montreal	.10	....	.....
Baltimore	.124	.268	.....
Atlanta	.068	*.125*	.....
Dallas	.103	.19	.31
Birmingham	.11	.124	.255
Pittsburgh	.068	.128	.179
Cleveland	*.06*	.12	.....

STRUCTURAL MATERIAL—Following are base prices per 100 lb. in carload lots, f.o.b. mill, Pittsburgh and Birmingham. At other cities listed, quotations apply on less-than-carload lots from warehouses:

	Pittsburgh	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	*$1.75*	*$1.90@$2.00*	$3.34	$4 00	$3.25	$3.10	$3 00
Channels, 3 to 15 in.	*1.75*	*1.90@ 2.00*	3.34	4.00	3.25	3.10	3.00
Angles, 3 to 6 in., ¼ in. thick	*1.75*	*1.90@ 2.00*	3.34	4.00	3.25	3.10	3 00
Tees, 3 in. and larger	*1.75*	*1.90@ 2.00*	3.34	4.00	3.35	3.10	3 00
Plates, ¼ in. thick and heavier	*1.75*	*1.90@ 2.00*	3.34	4.00	3.25	3.10	3.00

RIVETS—The following quotations are per 100 lb.:

ROUND-HEAD STRUCTURAL

	Pittsburgh Mill	Warehouse: New York, Nov. 3	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	.$2.75@$3.00	$5.00	$4.20	$3.60	$3.75	$5.50	$4.75
	CONE-HEAD BOILER						
½ in.	**$3.25**	$5.00	$4.40	$3.60	$3.90	$5.50	$5.00
⅝ and ¾	**3.40**	5.15	4.55	3.70	4 10	5.65	5.15
⅞ and 1	**3.55**	5.40	4.80	3.95	4.15	5.85	5.50

NAILS—The following quotations are per 100 lb. keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.55	$2.85	$2.95	$3.25	$4.25	$2.83	$4.95
Cut	2.80	2.90	....	*4.90*	5.00	2.95	5.00

SHIP SPIKES—Current prices per 100 lb.:

In	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	*$7.30*	*$5.55*	$7.75
⅝	*6.85*	*5.10*	5.65
¾	*6.70*	*4.95*	5.50

Pittsburgh base in lots of 200 kegs or more, **$3.30**.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls weighing 85 to 90 lb. costs $1.93½ per square to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $5.62½ per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in 1) f.o.b. New York, in carload lots to contractors, $4.27½ per square for the hexagonal shape, with Underwriters' label.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tarred felt per 100 lb	$2.94½
Asphalt coating, per gal	.31½
Asphalt felt, per 100 lb	3.09

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 88 per cent; "B," 89 per cent. Double thickness "AA," 83 per cent; "A," 88 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations at mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	*$2.10@2.15*	$3.60	$3.50	$3 75	$3.89
No. 12	*2.15@2.20*	3.65	3.55	3.80	3.94
No. 14	*2.20@2.25*	3.70	3.60	3.85	3.99
No. 16	*2.30@2.35*	3.80	3.70	3.95	4.09
Black					
Nos. 18 to 20	*$2.70*	4.25	3.75	4 60	4.00
No. 22	*2.85*	4.40	3.90	4 75	4.15
No. 24	*2.90*	4.45	3.95	4 80	4.20
No. 26	*3.00*	4.55	4.05	4 90	4.30
No. 28	*3.15*	4.70	4.20	5.05	4.45
Galvanized					
No. 10	*3.05*	4.55	4.10	4.65	4.25
Nos. 12 to 14	*3.15*	4.65	4.20	4.75	4.35
No. 16	*3.25*	4.75	4.30	4 85	4.45
No. 18	*3.40*	4.90	4.45	5 00	4 60
No. 20	*3.55*	5.05	4.60	5 15	4 75
No. 22	*3.60*	5.10	4.65	5 20	4 80
No. 24	*3.75*	5.25	4.80	5.35	4 95
No. 26	*4.00*	5.50	5.05	5 60	5 20
No. 28	*4.25*	5.75	5.30	5.85	5.45

For galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per 7½-lb. gallon for raw oil:

	New York: Nov. 3	New York: One Year Ago	Chicago: Nov. 3	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	*$0.78½*	*@$0.87*	**$0.79**	$0.85

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Nov. 3	1 Yr. Ago	Nov. 3	1 Yr. Ago
Red	$13.75	$15.25	$15.25	$16.75
White	13.75	15.25	13.75	15.25

Lumber

Prices wholesale, per M. ft. b.m., in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to contractors at yards.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers:

	New York		Chicago	
	20 Ft. and Under L.L.Y.P.	22-24 Ft. L.L.Y.P.	20 Ft. and Under No.1 L.L.Y.P.	Up to 32 Ft. No.1 Douglas Fir
3x4 to 8x8	*$41.00@42.00*	*$42.00@43.00*	*$37.00*	$39 50
3x10 to 10x10	*48.00@49.00*	*49.00@50.00*	45.00	39.50
3x12 to 12x12	*55.00@56.00*	*56.00@57.00*	**55.00**	39 50
3x14 to 14x14	*63.00@64.00*	*64.00@65.00*	.....	39 50
3x16 to 16x16	*75.00@76.00*	*76.00@77.00*	.....	40.50

New York—Prices are for long-leaf yellow pine timbers (rough) to dealers, alongside dock. Price to contractors, delivered by trucks from lighters to job, $5@$10 additional. Short leaf pine costs $3 per M. ft. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. and $1 for each additional foot from 32 to 36 ft.

Other Cities—On cars or at dock:

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	**$48.00**	$47.50	$49.00	$52.00	**$57.50**	$57.00
Seattle	.....	24.00	.....	.....	.....	24.00
New Orleans	45.00	.....	.....	.....	50.00	.....
Baltimore	35 00	49.25	53.00	60.00	.....	49.75
Cincinnati	50.00	.....	.....	.....	65.00	.....
Montreal	55.00	.....	.....	.....	60.00	50.00
Los Angeles	.....	32.00	.....	**32.00**	.....	32 00
Denver	.....	33.25	34.25	34.25	.....	34 25
Minneapolis	42.50	36.75	**34.50**	.....	47 00	38.75
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	56.00	.....	.....	.....	56.00	.....
Kansas City, Mo.	**40 50**	39.75	.....	.....	**54.50**	39.75
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	48.00	*35.00*	**40.00**	45.00	*60.00*	*35.00*
Detroit	44.00	41.50	.....	.....	55.00	41.50
St. Louis	39.00	.....	.....	.....	51.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	**$43.50**	$43.00	$44.50	**$48.50**	$48.00
Seattle	.....	22.00	.....	.....	23.50
New Orleans	30 00	.....	.....	.....	.....
Baltimore	55 00	44.00	44.00	34.00	49.50
Cincinnati	42.50	.....	.....	40.00	.....
Montreal	45.00	55.00	40.00	65.00	50.00
Los Angeles	.....	24.50	.....	.....	36.00
Denver	.....	32.75	33.25	.....	32.25
Minneapolis	40 50	36.25	34.75	35 50	35.00
Atlanta	22.00	.....	.....	28.00	.....
Dallas	52 25	.....	.....	56.00	.....
Kansas City, Mo.	50.25	*41.75*	.....	39.75	**37.75**
Birmingham	27 00	.....	.....	45.00	.....
Philadelphia	**32 00**	*35.00*	**37.00**	*50.00*	*35.00*
Detroit	40 50	37.00	.....	30.50	41.25
St. Louis	38.00	.....	.....	28.00	.....

*Douglas fir.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	**5 in.**	**80 to 89 ft.**	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Nov. 3	One Month Ago	One Year Ago
$2.20@$2.25	$2.20@$2.25	$2.25@$2.35

CONCRETE BLOCKS—Standard 8x8x16-in., delivered to job, each:

Denver	$0.22	St. Louis	$0.20
Detroit	.16	Boston	.18@.20
New Orleans	....	Minneapolis	.14*
Brooklyn and Queens	.18@.20	Philadelphia	.18@.20
Pittsburgh	.18@**20**	*F.o.b.	

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft.; ½-in., 6; ⅝-in., 4½; ¾-in., 3½; ⅞-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following are prices per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.24½	New Orleans	$0.20
New York	.**26**	Los Angeles	.25
Chicago	.23½	Seattle	.23
Minneapolis	.25½	St. Louis	.22½
San Francisco	.22½	Montreal	.17
Atlanta	.*22*	Detroit	.24½
Denver	.25½@.26½	Baltimore	.18
Cincinnati	.21	Kansas City	.25½
Dallas	.31	Birmingham	.26@.27
Philadelphia	.**25**		

EXPLOSIVES—Price per pound for dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265*	$0.2875*
Boston	.235	.265
Kansas City	.205	.225
Seattle	.165	.19
Chicago	.195†	.2175†
Minneapolis	.1917	.2123
St. Louis	.22	.24½
Denver	.2025	.2275
Dallas	.225	.306
Los Angeles	.1875	.2225
Atlanta	**.245**	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.1675	.1895
Birmingham	.22	.24
New Orleans	.235	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

*Special gelatin in case lots. †Quantities above 500. lb., and less than a ton.

CHEMICALS—Water and sewage treatment chemicals, round lots at New York:

Sulphate of aluminum, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	5.00@5.10
Soda ash, 58%, in bags, per 100 lb	1.32½@1.37½
Chlorine, liquid, cylinders, per lb	.05½@.08
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	2.00@2.10*

*F. o. b. works.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.